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Towards Improving the Practice of Adaptive Management in the New Zealand Conservation Context

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Abstract of a thesis submitted in partial fulfilment of the
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Towards Improving the Practice of Adaptive Management in the New Zealand Conservation Context

by C.L. Jacobson

Adaptive management has been proposed as a learning-oriented approach to environmental management where uncertainty exists. While the approach appears scientifically sound, it remains challenging to implement, with few successful examples in practice. In Aotearoa-New Zealand, the approach is relatively new, especially within conservation management. The goal of this research was to develop an understanding about the ways in which to support its adoption and practice in this context.

Through synthesis of the international literature, I argue that the resolution of practice-based concerns about adaptive management requires a focus on practice context, rather than serving to emphasise differences in discipline-derived discourse. A context focus is enabled in this research by the use of reflection building approaches, including formative evaluation, joint inquiry and individual reflection on group process.

The usefulness of these approaches for addressing the research goal is assessed using action research. Action research is an inductive research methodology involving an iterative and cyclical process of action and critical reflection on action. Subsequent research cycles enable substantive theory (about practice) to be developed. Five research cycles were undertaken. Three cycles were dedicated to the development and testing of a formative evaluation framework. The value of this framework for building reflection is evidenced in a multi-case analysis of the practice of adaptive management. Further, the value of alternative approaches to building reflection is also demonstrated.

This research has shown that the practice of adaptive management in New Zealand is typically specialist driven. I argue that this is, in part, due to the use of adaptive management as a model of science-based problem solving. The successful practice of adaptive management is therefore dependent on practitioners' ability to attend to tensions caused by interests other than those of improving the ability to confront complexity at the localised

management level. This research has proven that supporting practitioners in making explicit the underlying reasons for decisions about how to confront complexity can only serve to improve the likelihood of learning from them.

Key words

Adaptive management, Action research, conservation, context, Department of Conservation, evaluation, learning, New Zealand, inquiry, reflection.

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During the course of this thesis I have held a number of other professional roles, including teaching within the Environmental Management and Design Division at the University, and contract research for the Collaborative Learning Group, Manaaki Whenua-Landcare Research Ltd. These networks have provided further opportunity for engaging discussion of which I am grateful – thanks to Margaret Kilvington, Chrys Horn, Peter Gossman and Ian Domigan in particular and least I forget, the support teams in both organisations.

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Glossary and Papakupu (including Māori terms)

Adaptive learning	Adaptive learning describes the learning process inherent in adaptive management, including reflection on goals and assumptions
Active adaptive management	The practice of adaptive management with an explicit model-building and management action simulation process
Adaptive management	A process of accumulating knowledge pertaining to an area and the systematic modelling of that knowledge in order to identify key uncertainties in management which are then explicitly explored through the application of management actions, the outcomes of which are used to guide future management
Adaptive experimental management	The practice of adaptive management with an emphasis on the implementation of management as a treatment in a scientific sense
Adaptive collaborative management	The practice of adaptive management with an emphasis on interactions between various actors involved in a project's management
Adaptive environmental assessment and management	The original term used to describe the process of adaptive management by Holling (1978)
Cross-case analysis	A process of contrasting multiple data cases in order to strengthen inference
Epistemology	Theory on the creation of knowledge
Iwi	Tribe
Kaitiakitanga	Guardianship
Kawanatanga	Governorship
Mainland Islands	Six Department of conservation ecosystem-style conservation projects (TKP, NTUERP, BSMI, PSR, RNRP and HMI) established from the same funding pool and reported on separately from other DOC conservation projects. Note that many other projects (within and outside of DOC) may have similar goals, management and underpinning management philosophy
Māori	New Zealand's indigenous people
Matauranga Māori	Traditional Māori knowledge
Pakeha	Person of European ancestry

Passive adaptive management	The practice of adaptive management without an explicit model-building process
Positivism	Epistemology associated with science in the 20th century (i.e., the hypothetico-deductive method)
Reflection	A process of considering one's experience. Three levels are referred to in this thesis: • Level one reflection (reflection on action) • Level two reflection (reflection on assumptions) • Level three reflection (reconsideration of an issue of interest)
Reflexivity	The process of responding to an old issue or action in light of new information
Rohe	Area/region
Social learning	Learning that occurs in a social context
Tall-poppy syndrome	A New Zealand cultural phenomenon whereby high achieving individuals or projects are viewed as drawing too much attention away from the achievements and endeavours of others. This is often addressed by removing support that enables that achievement to be sustained
Takata whenua/ Tangata whenua	Māori people
Te Reo	The Māori language
Te Tiriti (O Waitangi)	The Treaty of Waitangi
Tinorangatiratanga	Translations include 'absolute sovereignty' and 'self-determination'
Tōpuni	A legislated area of legitimised special interest under the Ngai Tahu Deed of Settlement, Ngai Tahu Claims Settlement Act (1998)

List of Acronyms

AAM	Active Adaptive Management
ACM	Adaptive Collaborative Management
AEAM	Adaptive Environmental Assessment and Management
AEM	Adaptive Experimental Management
AM	Adaptive Management
AR	Action Research
BRU	Biodiversity Recovery Unit (a division of the Department of Conservation
BSMI	Boundary Stream Mainland Island
CSM	Critical Systems Methodology
DOC	Department of Conservation
FAD	Forests Affected by Deer – Department of Conservation research investigation no. 3673
HMI	Hurunui Mainland Island
MI	Mainland Island
NTUERP	Northern Te Urewera Ecosystem Restoration Project
NHIMS	Natural Heritage Information Management System
PAM	Passive-Adaptive Management
PAR	Participatory Action Research
PSR	Paengaroa Scenic Reserve
RNRP	Rotoiti Nature Recovery Project
RO	A Department of Conservation Regional Office
SSM	Soft Systems Methodology
STI	Science, Technology and Improvement (a division of Department of Conservation)
TKP	Trounson Kauri Park

Chapter One: Introduction

1.1 Introduction

Over the past 50 years, recognition that the traditional emphasis of environmental management has not enabled effective management in situations where uncertainty and complexity exist has grown. Gunderson *et al.* (1995) and Holling and Meffe (1996) describe the problems associated with what they refer to as the 'command control pathology' of environmental management. They argue (*ibid*) that increasing demands for natural resources and for consistency in levels of production has led to the oversimplifications of management context, a failure to acknowledge uncertainty in data and over-control of natural patterns of variation in ecological systems, resulting in the collapse of ecological systems and associated communities and economies.

Central to the concerns raised by Gunderson *et al.* (1995), and supported by Holling and Meffe (1996), is the need for new ways of managing situations where uncertainty and complexity prevail. Uncertainty in natural resource management is derived from multiple and often competing land use objectives, from multiple unpredictable effects of management actions, from the many stakeholders associated with a resource and from multiple and often overlapping jurisdictional responsibilities (Keeny 1982).

One response to management where uncertainty and complexity exist has been a call for increased contributions from science so that systems are understood in a way that enables resource use to be optimised. This has been supported in the development of sciences associated with the comprehension of complex systems, as is evidenced in the following quote from Tyson (2001:2): "complex, multi-faceted phenomena can only be comprehended by understanding the nature of their connections and disconnections over time and space. A view of any phenomenon based on its parts alone lacks integrity". However, as Holling (1995:5) notes, this has led to a situation in which resource management agencies have come to view "science's role as the provider of data needed for litigation". Further, Holling (*ibid*) suggests that ecological uncertainties associated with systems are often negated, or an optimistic estimate taken when informing policy and management choice (for example, see Walters and Holling 1984, Arkinstall 1995, and Yaffee 1997). Where ecological uncertainty exists and specialist responses are incongruent, managing institutions may choose to accept evidence that conforms with their views and desires for the system being managed, rather than

accepting uncertainty as a signal for an alternative approach to management (Hutchings *et al.* 1997). The presence of management uncertainties can therefore lead to false expectations of science (Hanley 1994, Starzomski *et al.* 2004).

Uncertainty cannot be ignored however. Managing in the face of uncertainty requires recognition that science cannot be separated from values and equity in decision-making (Ludwig *et al.* 2001, Hill and Coombes 2004). Whilst managing complex systems requires simplification of ecological and social complexity for effective management, in situations where ecological uncertainty and a diversity of social values and goals exist, alternative approaches to management may be needed. In recognising uncertainty in management, there is a clear need for learning oriented approaches that recognise social, ecological and economic system interactions as they relate to particular contexts. Collectively, the recognition of complexity, uncertainty and inter-relationships between social and ecological systems in management is tacitly associated with a 'new paradigm' in environmental management.

1.2 A new paradigm for environmental management

A 'new paradigm' in environmental management has been signalled by several authors (for example, Lister 1998, Funtowicz and Ravetz 1994, Kay and Schneider 1994)[1]. This paradigm can be considered a response to inter-related developments in the world-view of science, and demands for increased participation in environmental management where citizens' values and livelihoods are affected.

The emergent world-view is typically characterised by:

- Recognition of unequal influence of systems components on system behaviour, both in relation to the role of different species (e.g., keystone species (Simberloff 1998)) and in cyclic movement between multiple 'states' or zones of stability (Holling 1973);
- Recognition of dynamic interactions of system components that result in self-organised hierarchies with the ability to re-organise (Kay and Schneider 1994); and
- Recognition that diversity in ecological, social and economic systems contributes to their resilience (Holling and Meffe 1996, Gunderson and Holling 2002), and recognition of multiple levels of ecological, social and economic organisation that interact with each other at a range of scales (Levin 1992).

[1] It should be noted that tacit links to this new paradigm came much earlier, for example Lovelock (1979) and Norgaard (1984).

As such, systems are recognised as inherently more complex – particularly those operating on broad spatial and temporal scales (e.g., tropical rain forests). As noted by Hill and Coombes (2004:48) "uncertainty confounded past approaches to management which over-stated scientists' capacity to predict the future state of the environment". Hence, there is recognition that learning-oriented approaches to environmental management are required, given that "science alone has not, does not, and will not produce the 'right answer'" (Sexton 1998:111).

Learning-oriented approaches are considered essential in management where uncertainty exists. They enable assumptions supporting different courses of management to be espoused and tested, and understanding to be developed through the application of management as an experiment. Recognition of uncertainty, propelled by the interdependence of ecological, social and economic systems has also resulted in a greater inter-disciplinary emphasis in management. In order to loosen command and control approaches and manage the politicisation of ecological uncertainty in management decision-making, participatory processes which aim to include those directly affected by management with the decision-making process have been increasingly supported. The use of participatory processes has led to arguments for increased consideration of the effects of uncertainties on values and livelihoods, and the potential contribution that local and indigenous knowledge can make in managing uncertainty (e.g., Roling and Wagemakers 1998, Berkes *et al.* 1999, Allen 2001b, Olsson and Folke 2001). Thus, the new paradigm of environmental management is one that recognises humans as dwelling in nature. Rather than attempting to isolate humans from nature for nature's own benefit, or assuming that humans can successfully dominate nature for their own ends, it emphasises the importance of learning to respond to feedback in an attempt to manage the environment in a more sustainable way.

1.2.1 Learning-oriented approaches to management

A plethora of new approaches has been developed in response to the need for learning-oriented approaches, e.g., Integrated Natural Resource Management, Sustainable Community Development and Ecosystem Management. Another commonly identified approach is that of adaptive management. Adaptive management is a learning-based approach to management developed in the field of natural resource management. Although a raft of definitions exist, for the purposes of this thesis I have defined it as "*A process of accumulating knowledge pertaining to an area and the systematic modelling of that knowledge in order to identify key uncertainties in management which are then explicitly explored through the application of management actions, the outcomes of which are used to guide future management.*"

The development of adaptive management can be traced to its roots as a science-oriented approach to reducing uncertainty of policies by modelling systems and testing collaboratively formulated policy options (Holling 1978, Walters and Hilborn 1978). The learning process inherent in adaptive management is similar to models of management from other fields (e.g., Total Quality Management within the management sciences (Boaden 1996, Woleck 1999), and environmental management systems (Robèrt *et al.* 2002), and indeed to the processes managers themselves use to adapt. However, its application within environmental management explicitly emphasises consideration of the complexity of the natural environment and the need to manage inter-related social, economic and environmental uncertainties as they relate by using system models.

Adaptive management is proposed for situations where ecological uncertainty exists. Initially, it was applied in relation to production systems including fisheries and forestry management (e.g., Gunderson *et al.* 1995). More recently, it has been applied to the management of a range of resources (both internationally and in New Zealand), e.g., grasslands (Allen 2001a, Allen *et al.* 2001) and increasingly for management that fits within a protectionist mandate, including wetland management (Anon. 2000), pest management (Parkes *et al.* 2000, Allen *et al.* 2001) and threatened species management (Innes *et al.* 1998, Bearlin *et al.* 2002), and in developmental situations that integrate protectionist and production mandates (Agrawal 2002, Argumendo and Mamen 2002).

Adaptive management has been linked to both theory and practice in a range of initiatives that support environmental management, including ecosystem management (e.g., Grumbine 1994, Meffe *et al.* 2002), sustainable community development (e.g., Buck *et al.* 2001, Oglethorpe 2002), collaborative learning (e.g., Blumenthal and Jannick 2000), large-scale experimentation (e.g., Walters and Holling 1990), decision analysis (e.g., Williams and Johnson 1997), policy development and implementation (e.g., Lee 1993a, 1999, Mitchell 1997), learning theory (e.g., Allen 2001b, Salafsky *et al.* 2001) and even traditional ecological knowledge (e.g., Berkes *et al.* 2000). However, like many learning-oriented approaches, adaptive management appears to have been more promising in theory than it has proven to be in practice (McLain and Lee 1996, Lee 1999).

These applications of adaptive management have resulted in a plurality of perspectives on the approach and a range of normative descriptions. Whilst these make a natural and valuable contribution to academic debate, they have proven problematic for improving the practice of

the approach and in supporting the transition of environmental management to a more adaptive, transparent and accommodating approach (Lee 1999). At the core of this problem is the challenge of confronting uncertainty that arises from increased awareness of complexity, as is evidenced in Plate One. Adaptive management theorists and practitioners have also emphasised that efforts to apply the approach have suffered through a lack of consideration of the social and institutional context (Lee 1993b, 1999, Allen 2001b)[2]. Hence, there is a clear need for research that supports reflection on the adoption and practice of more adaptive approaches to management, and the ways in which this is constrained by management context (Allan 2004).

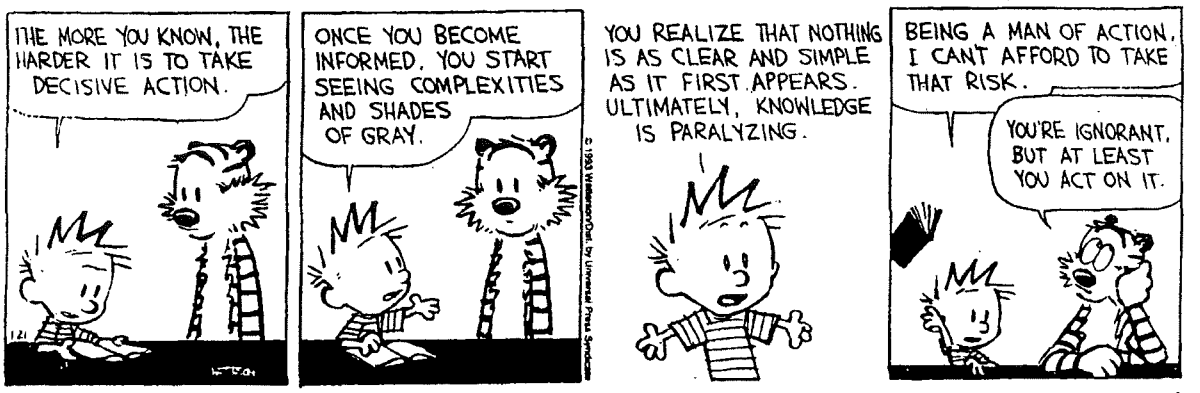

Plate 1: The challenge of uncertainty can lead to management actions based on ignorance, or a paralysing sense of inaction (Calvin and Hobbes © Watterson, in Hummel and Frett 1999).

1.2.2 Adaptive management in Aotearoa-New Zealand

Adaptive management, as a formalised model of environmental management, is relatively new in New Zealand. There are few case-studies that explicitly identify themselves as attempting to implement adaptive management. However, this does not mean it is not knowingly or unknowingly practiced. In cases where adaptive management is being practiced, its interpretation appears polarised. In the fisheries sector, adaptive management has been suggested for the management of Paua (Stevens 2001), and has been implemented in the management of the depleted Orange Roughy fishery (Clark 1995, Starr *et al.* 1996). However, in the case of the latter adaptive management was viewed as a 'once only' process, whereby appropriate fishery catch volume was determined over a five year period without plans for ongoing learning. A report on research directions for fisheries produced by the New Zealand Ministry of Fisheries states that "The application of true adaptive management techniques incorporating experimental fishing and decision rules should be further investigated" (Ministry of Fisheries, N.D.). However, whilst international experiences of adaptive

[2] It is worthwhile to note that these arguments have been mirrored in analyses of the potential contributions of the social sciences to inter-disciplinary environmental research in general (see Scoones 1999).

management have placed emphasis on public involvement in planning and decision making (e.g., Hilborn 1992, Butler *et al.* 2000), and the New Zealand Quota Management System clearly allows for participation, there is little clear evidence that participation in its various forms is considered part of the practice of adaptive management.

Arguments for the use of adaptive management in the agricultural sector in New Zealand are also evident. A report published by the New Zealand Ministry of Agriculture and Forestry (Perley *et al.* 2001) claims an urgent need for adaptive management in order to safeguard New Zealand's agricultural biodiversity. Adaptive management has also been suggested as an approach for the mitigation and management of the effects of the dairy industry (Crawford 2001), particularly given limitations in the existing understanding of soil nutrient processes (Webb *et al.* 2002). Examples of projects explicitly describing themselves as adaptive management within the agriculture sector are limited. An exception is the initiation of an adaptive management programme in the New Zealand High Country, where agricultural practices are often identified as being responsible for dramatic changes to tussock grassland communities (Allen *et al.* 2001). One initiative developed as part of this programme has been to address issues regarding access to information that supports more sustainable land management practices (Jacobson 2001, Allen 2001b). Hence, in this sector both social and ecological facets of adaptive management are emphasised.

Another environmental management context characterised by high levels of uncertainty and therefore the need for learning is the conservation management context. New Zealand's conservation management sector also has experience in the practice of adaptive management. Management of conservation in New Zealand is largely driven by the Department of Conservation (DOC) who are the government agency charged with the responsibility of managing approximately 30% of the landscape under a primarily preservationist mandate (Craig *et al.* 2000). Conservation management is characterised by a terrestrial focus, given high levels of endemism (Wilson 2004) and a broad range of recently introduced taxa that threaten both flora and fauna (Craig *et al.* 2000). Since the inception of DOC in 1987, conservation management has moved away from a traditional species emphasis towards a more holistic ecosystem emphasis (Park 2000, DOC 2005b). This ecosystem emphasis, alongside the recent biodiversity denigration wrought by landscape level vegetation clearance and by introduced species has, in combination, resulted in numerous uncertainties for management and a recognised need for alternative learning-oriented approaches to management. To these ends, adaptive management has been considered an alternative

approach to management. Both collaborative and experimental emphases in adaptive management are evident in conservation management in New Zealand (e.g., Saunders 1999, Forgie *et al.* 2001, Parkes *et al.* 2000), echoing the plurality of perspectives evident internationally (e.g., Johnson and Williams 1999, Allen 2001b).

1.3 Thesis aim and research questions

Adaptive management, in theory, provides a significant advance in thinking about how to manage natural resources in instances where uncertainty prevails (Holling 1978). A review of the literature on adaptive management indicates that its practice is characterised by a lack of recognition of the implications of the different emphases that exist in practice. Adaptive management appears scientifically sound, but there are few cases that explicitly identify themselves as successful in practice. Academics suggest that the social context (institutions, partnerships and group processes) are at issue (Gunderson *et al.* 1995, Johnson 1999a, Lee 1999). Internationally, there is a need for synthesis of the existing perspectives on adaptive management and understanding about the ways in which reflection-building approaches can contribute towards improving its practice.

The relatively recent practice of adaptive management within the conservation context in New Zealand could result in situations similar to that described in international examples where adaptive management has become something of a 'buzz word' (Parma *et al.* 1998, Duncan 2001, Roe and van Eeten 2002, Wildhere 2002) rather than being adopted and implemented in ways that attend to the concerns driving its inception. Further, without consideration of current issues facing the practice of adaptive management internationally, New Zealand is at risk of failing to learn from international experience.

The need for research on the use of adaptive approaches to managing uncertainty and the newness of adaptive management to New Zealand provides a timely opportunity to explore ways in which to support its adoption and practice. The overall goal of this research was to develop an understanding about ways in which to support the adoption and practice of adaptive management within the New Zealand terrestrial conservation setting.

The two questions that guided this research are:

Question 1: In what ways are current interpretations of adaptive management limiting its practice?

Question 2: What contributions can reflection-building approaches make in supporting the adoption and practice of adaptive management in the New Zealand terrestrial conservation management context?

These research questions and the over-arching research goal have resulted in two defining research characteristics. Firstly, the improvement of actual practice, rather than theory about practice, necessitates a 'home' for such an attempt. This thesis is necessarily case-study driven, focussing on depth of understanding rather than the ability to generalise from it (Yin 1984). Secondly, the desire to improve practice also requires the use of an action-oriented methodology that is reflexive to the needs of a given situation. To these ends, the contributions made in this thesis are driven by the ability to utilise particular approaches within opportune case studies. As a consequence of this need for flexibility, the thesis was not hypothesis driven. Doing so would have resulted in preconceived ideas about the practice of adaptive management, and would have resulted in the research being ignorant about the richness of existing perspectives and the implications of these for the adoption and practice of adaptive management in the case studies.

1.4 Methodological outline

The methodology used in this thesis is action research, an inductive methodology involving an iterative and cyclical process of planning, action, observation, and critical reflection on observation (Dick 2002). Action research involves an explicit intent to develop understanding about practice through the process of reflection on practice, rather than focusing on observations of a phenomenon within controlled conditions as positivist science has traditionally involved. Thus, action research results in data and analysis in relation to both practice context and the process used to support practice. In the case of this thesis, the practice of interest is the practice of adaptive management, and the cases are New Zealand conservation projects where adaptive management is either being explicitly practiced or is considered desirable for practice.

Action research is considered an appropriate methodology for this thesis, given the emphasis on the ways in which reflection can be used to support the practice of adaptive management. In this thesis, action research is applied as a meta-methodology, providing a way of exploring

different approaches for building reflection on practice, including formative evaluation, group inquiry and individual reflection on the social-learning process. The 'data' component of this research is based on five inter-linked research cycles, grounded in theoretical development relating to the practice of adaptive management and its use within the New Zealand conservation management context. Successive research cycles represent development and exploration of emergent issues related to the practice of adaptive management. As a result of these research cycles, a reflective model of adaptive management is developed, and conclusions are drawn about the practice of adaptive management that are relevant to the New Zealand context and beyond. Figure 1.1 presents a diagrammatical representation of this process. Although action research is presented here as a linear process, the practice of action research is seldom so.

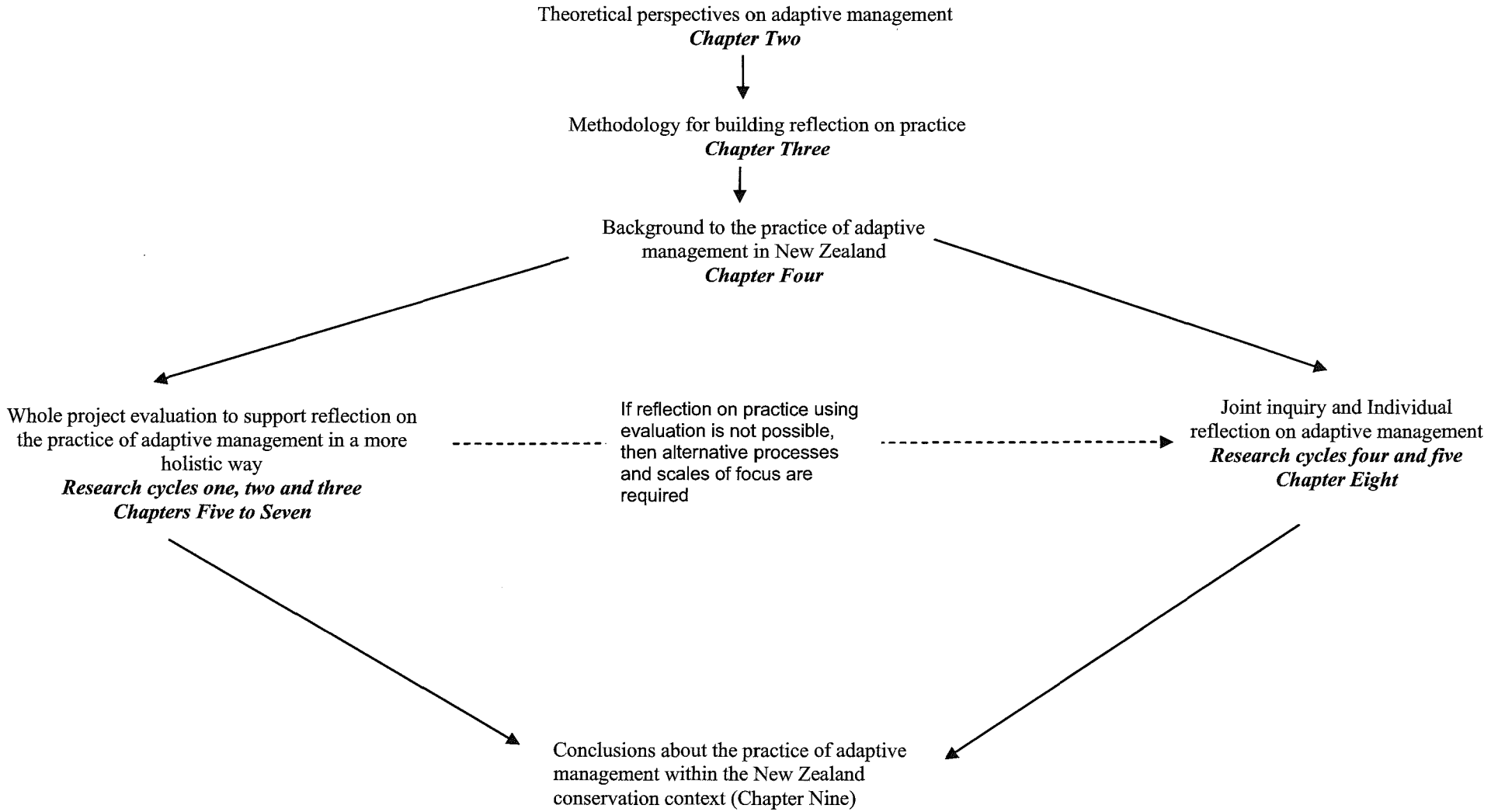

Figure 1.1 Analysis schematic for the thesis (dotted line shows argument progression).

1.5 Thesis overview

This thesis consists of nine chapters, including this one. In Chapter Two, I outline different discourses on adaptive management, describe the issues associated with them, build the argument for increased reflection on the practice of adaptive management and introduce approaches for doing so. In Chapter Three, I outline the methodology of action research, and the key methods used in subsequent chapters. In Chapter Four, I provide a background to the context of conservation management in New Zealand, including the case studies used in subsequent chapters. In Chapter Five, I present the results of a scoping study on the practice of adaptive management in New Zealand which supports the notion that polarised perspectives on the practice of adaptive management exist, justifying the development of a framework to support formative evaluation of adaptive management projects. In Chapter Six, an evaluation of perspectives on adaptive management in the Mainland Islands highlights the problems associated with multiple discourses on adaptive management and leads to the re-development of criteria derived from the literature review in Chapter Two. In Chapter Seven, I test and refines and demonstrate the value of this framework for (re)coupling both social and experimental emphases on the practice of adaptive management, and for developing lessons on the practice of adaptive management via meta-analysis. In Chapter Eight, I consider two alternative approaches for supporting reflection when access to evaluate 'whole' cases is not possible. These cases are used to highlight a number of trade-offs that occur in the adoption and practice of adaptive management. Lastly, in Chapter Nine, I present conclusions relating to the practice of adaptive management in the conservation context in New Zealand (and beyond), and detail some avenues for further research.

In addition to this thesis itself, I have developed a website containing links to on-line information and examples of adaptive management. When I initiated this research, much of the information on adaptive management and the practice-derived lessons were only available online. While the internet remains a valid mechanism for sharing information in evolving fields such as adaptive management, sough after information can be somewhat difficult to find. In order to share the resources I had found, I developed a website of resource links (Http://student.lincoln.ac.nz), a version of which is included on a CD-ROM in Appendix One (at the time of thesis submission, the site is in the process of being updated and moved to a private server).

1.6 Confessions of a researcher

Central to the practice of any qualitative research, including action research (Tolich and Davidson 1999, Dick 2002), and to adaptive management as I argue in this thesis, is the practice of reflection. Reflection starts with the individual researcher including the values and interests they bring to the research, and their potential influence on the research process.

My personal background, as a New Zealander who was raised to appreciate the opportunities for recreation afforded by the easy access to wilderness areas has led to a profound love of New Zealand's indigenous landscapes. These interests led to the completion of a degree in ecological sciences and postgraduate studies in Wildlife Management. At various stages I have plied my training as an employee of both the Department of Conservation and Landcare Research (formerly a Crown Research Institute but now a limited liability company), organisations that specialise in research on indigenous landscapes and their management. During this time, I came to be somewhat critical of the tacit position held within the sciences (and initially by myself as a newly trained graduate) that environmental management, and conservation management in particular, would be more effective if only managers would pay more attention to scientists.

Whilst I was first introduced to adaptive management early in my university training, a turning point for my interest in the social aspects of conservation management came when I attended He Meninga Whakatu Hua O Te Ao – a co-management hui (meeting) held in my rohe (home town) in 2000. While there, I came to realise that those practicing science must learn to listen to the concerns of managers if they wanted managers to listen to their concerns. My interest in the collaborative aspects of learning for environmental management is hence driven by the concern for voice and the need to listen in order to be able to learn how to manage. This interest, and my scepticism of the role ecological science has paved for itself in interacting with management, influenced my initial position on adaptive management, i.e., that increased awareness of the social context of management is needed.

Since December 2000, I have been working on a casual basis as a subcontractor to the Collaborative Learning Group at Landcare Research, particularly with Will Allen, the Leader of this group and also one of my supervisors. My involvement with this group, and my working relation with Will led to a research role within an adaptive management project funded by DOC. Chapter Eight of this thesis was attached to this project, and I cannot discount the various discussions I have had with Will that have influenced my own reflections

on the research presented in that chapter, particularly with regards to ethical issues. Equally, I cannot discount the contributions of various others, including my supervisors, colleagues at university, other practitioners of adaptive management from within New Zealand and Australia, DOC staff and scientists, and community members who have contributed as research collaborators, participants and critical friends. Ultimately, this thesis represents my own reflections, developed through critical analysis, on the practice of adaptive management as an approach to conservation management in New Zealand.

The original contribution of this thesis lies in the intersection of several different 'disciplines', including learning, management, ecology, planning and systems sciences. What I hoped to achieve in this research was an understanding of the ways that applied social science can contribute to the sustained and successful practice of adaptive management. This began with a review of literature pertaining to adaptive management. Chapter Two presents this review, and my subsequent synthesis of it. As such, it provides the crucial theoretical underpinning of this thesis.

Chapter Two: Reflections on Adaptive Management

2.1 Introduction

The evolving practice of adaptive management has resulted in a plethora of interpretations and normative descriptions. In order to address the research questions outlined in Chapter One, consideration of multiple intersecting layers of theory (including that derived from practice) is necessary. This theoretical consideration provides the underpinning of subsequent chapters in this thesis, against which substantive theory (i.e., knowledge from experience) can be contrasted. This chapter begins by presenting a review of the literature pertaining to adaptive management, and highlights the significance of the contextual features that influence the practice of adaptive management (section 2.2). I then provide a synthesis of debates about how to learn from practice (section 2.3). In doing so, I argue that the current practice of adaptive management ought to be driven by critical reflection on context rather than by paradigmatical interpretations (section 2.4). As a consequence of this argument, I lastly introduce potential approaches for supporting reflection on practice. These include the first iteration of a framework developed with the intention of being used as part of a formative evaluation of adaptive management. I feel it is important here to revisit the methodological description given in Chapter One. Action research is an inductive methodology, i.e., one that supports theory development by substantive means. As this thesis research progressed, the process of working with particular cases inspired new literature syntheses; in turn, these supported a further, refined understanding of the adoption and practice of adaptive management in particular contexts.

The process of adaptive management and the steps involved are depicted in Figure 2.1. These steps include problem scoping, model building, action, monitoring and evaluation. Whilst these steps are not separate in practice and may in fact be overlapping (especially that of problem scoping and model building), each step clearly represents 'milestones' in practice. Management goal development is progressively refined through steps one to three, and revisited in step five. The implementation of each step may differ. For example, variety exists in the perspectives included within the problem scoping step, on the emphasis placed on model building (be it qualitative or quantitative) and in the rigour of management experimentation. Significantly, this depiction represents the process of adaptive management after the choice to adopt the approach to address a particular management problem has been

made. Thus, the usefulness of this model as a heuristic for adaptive management may depend on whether this decision has been made.

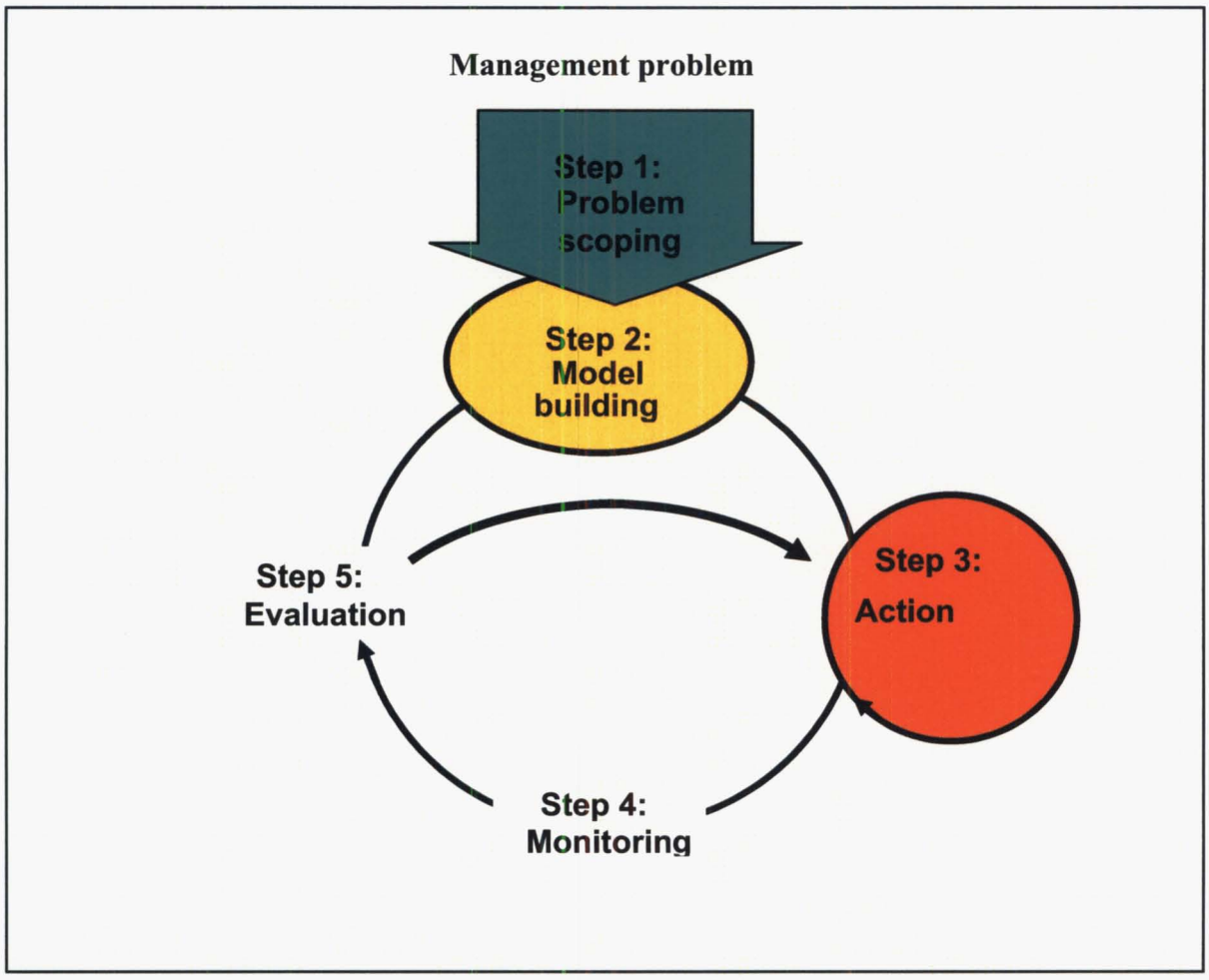

Figure 2.1 : Steps within the adaptive management process (adapted from Allen and Jacobson 2002).

2.2 Adaptive management in practice

The term 'Adaptive Management', as it relates to environmental management, originated from Buzz Holling's book *Adaptive Environmental Assessment and Management* (Holling 1978), which resulted from work completed by an interdisciplinary team of biologists and systems analysts at the International Institute of Applied Systems Analysis in Laxenburg, Vienna (Lee 1993a). This work was driven by concerns about the traditional procedures and principles applied in environmental management, including those within spruce forest management in New Brunswick, Canada, and within *Salmonoid* fisheries management in British Columbia, Canada (Holling 1978). Common myths utilised in the management of natural resources were critiqued, in particular the emphasis on creating stability of economically valuable harvests, the narrow focus adopted in ecological assessments, the lack of interdisciplinary scoping of environmental issues and the lack of credence given to ecological concerns in decision making. An alternative working model for environmental

assessment and management was proposed, whereby multiple policy or management options should be assessed by an interdisciplinary team of specialists who collectively model the ecological system of interest, thus enabling assumptions about system behaviour to be scrutinised. The robustness of these assumptions can then be tested by applying management actions in an experimental fashion, whereby policies and management decisions represent hypotheses about ecological system behaviour (*ibid*).

A diversity of thinking about, and practice of, adaptive management now exists. Consideration of practice context provides a useful starting place to understand this diversity. Figure 2.2 is designed to act as a starting point for reflecting on how socio-ecological context affects practice.

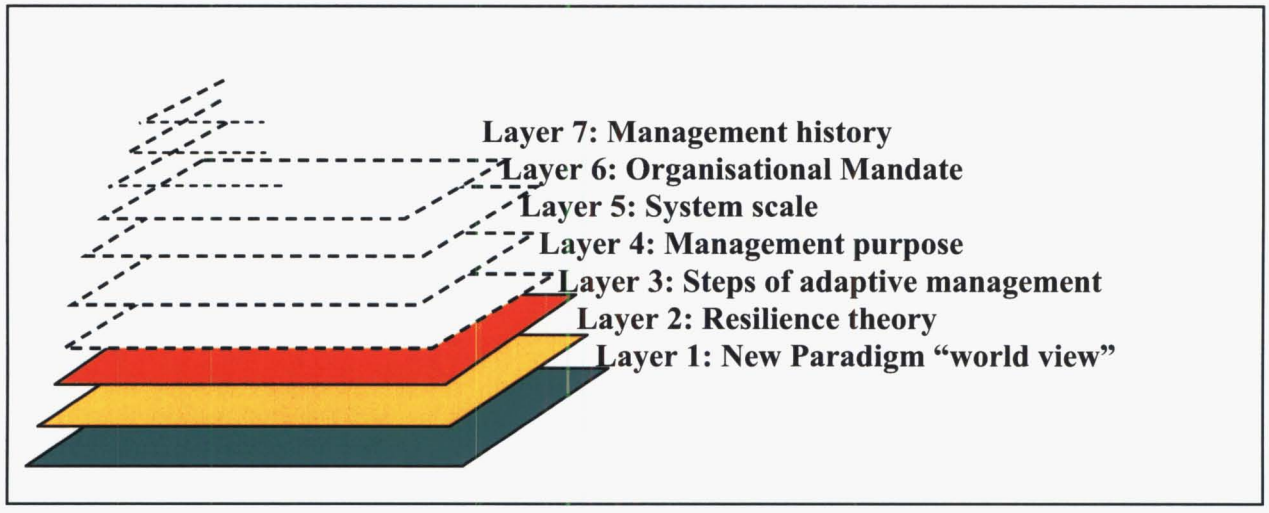

Figure 2.2: A re-conceptualisation of adaptive management. Layers 1 - 3 depict elements common across applications of adaptive management. Layers 4 – 7 represent elements dependent on context, the specific detail and order of which given here are hypothetical. Other elements not noted here may also be important, as is indicated by additional partial layers.

Developments in adaptive management are presented within this re-conceptualisation as a series of layers, some of which relate to common embodying elements of adaptive management, and others of which relate to emerging contextual challenges. Each additional layer in the figure represents increasing specificity in the practice of adaptive management and is constrained by influencing characteristics of the layers below. Further, whilst some information may permeate to the layer below allowing for the development of grounded norms, other information is less transferable. The sections that follow provide a more detailed analysis of the significance of commonalities and difference in the practice of adaptive management. Particular emphasis is given to differentiating elements given their significance to later developed arguments.

2.2.1 Common elements

Layers one to three of Figure 2.2 represent the conceptual under-pinning of adaptive management, a general appreciation of which is evident in most literature relating to the approach. Layer one includes those features of the world view associated with the 'new paradigm' in environmental management (as discussed in Chapter One), including recognition that system components differ in functional significance (Simberloff 1998), that systems are dynamic and self organising (Kay and Schneider 1994) and that diversity in systems contributes to their resilience (Gunderson and Holling 2002).

Layer two emphasises the conceptual underpinnings of adaptive management from its inception within the science literature. The development of adaptive management and the ensuing criticisms of traditional management highlighted in Holling (1978) and later by Holling and Meffe (1996) are related to earlier work on the nature of ecological systems and their behaviour. Holling (1973) argues that the persistence of relationships between components in ecological systems over time is more important than the nature of those relationships, especially in situations where a system's external environment is subject to change. Further, he argues that greater diversity in system componentry increases system resilience, i.e., the ability of a system to maintain relations whilst absorbing change. The application of this theory in management results in the acceptance of inherent changeability in systems. Delays of management until such time as comprehensive ecological understanding exists are therefore considered "delusory and often counter-productive" (Holling 1978:5). In other words, the illusion of an equilibrium state existing that leads to delayed decision-making because of large investments in science (which may be irrelevant by the time they are complete) can preclude management from investing in alternative and more relevant forms of information gathering, e.g., experimental styled management.

Holling's (1973) notion of system resilience has since been developed into a body of research[3] based on the premise that changes in a system's behaviour are related to its stored capital, diversity and resilience. In turn, differing levels of these attributes affect the ability of a system to influence and be influenced by its component systems and its external environment (Holling *et al.* 2000, Holling 2001, Gunderson and Holling 2002). Hence, so

[3] The development of ideas in this body of literature can be traced through the following authors: Walters and Holling 1984, Holling 1996, Berkes *et al.*1998, Peterson *et al.* 1998, Adger 2000, Gunderson 2000, Holling *et al.* 2000, Carpenter *et al.* 2001, Folke *et al.* 2002, Gunderson and Holling 2002, Berkes *et al.* 2003, and Ollson *et al.* 2003.

called 'resilience theory' acts as a kind of tautology for adaptive management. Importantly, this theory suggests resilience as a goal for management, given that a system's resilience affects its ability to withstand changes in interlinked socio-cultural, economic and ecological systems. The key to managing with resilience in mind requires a focus on the diversity of components and relationships in a system in order that systems are able to adapt to change (Walker *et al.* 2002).

Layer three of the diagram includes those key steps of adaptive management identified in Figure 2.1 of this chapter, including problem scoping, model building, action, monitoring and evaluation. These steps are evident in the original description of adaptive management by Holling (1978) and are common across different models of adaptive management (see section 2.3 of this chapter for more detail).

2.2.2 Differentiating elements

Layers four to seven of the diagram are proposed hypothetically (both in choice and order) as different elements of management context that affect the way in which adaptive management is practiced. It has long been argued that contextual constraints shape the practice of adaptive management. For example, many scholars of adaptive management (such as Holling (1978), Gunderson *et al.* (1995), Jiggins and Roling (2000), Light and Blann (2000a), and Salafsky *et al.* (2001)) suggest that the nature of systems themselves and future management success depend on the management history. Further, they suggest the methods for management are dependent on political, social and economic climates, management scale and the goals of management. Unfortunately, and perhaps symptomatic of Roe and Van Eetens' (2002) concerns about the paradigmatic interpretation of adaptive management, most case-study documentation is limited in the scope of analysis of management practice[4]. In some cases, details on requirements for 'good practice' are provided[5], but authors rarely reflect specifically on the way in which contextual constraints impact on practice. Attempting to identify the particular contextual elements that act as points of differentiation in practice and determining their relative importance is therefore difficult. Some reflections are however evident, and these reflections have led to the selection of elements labelled in layers four to seven.

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[4] Examples include Walters *et al.* (2002) who emphasise model development and use, Butler *et al.* (2001) who emphasise decision adjustment processes, (Gray 2000) who emphasises issue development, and Gibbs *et al.* (1999) who emphasises monitoring.

[5] Good examples of 'best practice' guides include Taylor (1997), Horsfield (1998), Light and Blann (2000a), Buck *et al.* (2001), Salafsky *et al.* (2001) and Meffe *et al.* (2002).

Applications of adaptive management to date have generally been for the purposes of either production or conservation. Each application type raises different issues for consideration in practice. Production-oriented applications of adaptive management are strongly affected by risk (social, economic, environmental or a combination thereof) associated with less-favourable management options (e.g., Arkinstal 1995, Gunderson *et al.* 1995, Hutchings *et al.* 1997), whilst applications for the purpose of conservation are considered problematic due to tensions between potential experimental actions and their effects on desired conservation outcomes (Peterson *et al.* 1997, Walters 1997, Meretsky *et al.* 2000). Further, small sample sizes in conservation cases limit the numbers of possible replicates and the flexibility for manipulation. This has the potential to affect the desired rigour of experiments.

As the spatial scale of ecological systems increases, so too does the complexity and uncertainty of the corresponding management system (Levin 1992). Large scale experiments are generally constrained by resources and hence less likely to deliver convincing outcomes (Walters and Green 1997, Raffaelli and Moller 2000), providing a trade-off between management scale and quality of science afforded (Roe and Van Eeten 2002). At broader management scales, there are typically more stakeholders who may influence management success. Thus, there is an increased likelihood of issues relating to inter-organisational and institutional collaboration and information sharing (Allen 1997, Light and Blann 2000a, Dovers and Mobbs 2001, ESA 2001). Further, as Lee (1993b) and Westley (1995) indicate, there is often a mismatch between scale and function of ecological and social (i.e., organisational and institutional) systems. In response to the complexity of issues arising from large-scale interests, it has been argued that adaptive management should only be applied in situations where such uncertainty is manageable (i.e., where organisations have a clear mandate for management) (Lee 1999). What is not clear however, is whether this argument stems from a lack of experience with processes designed to manage complexities associated with social systems, or whether it represents a limitation of current theory, or whether successful application of adaptive management is just not possible in these situations.

Organisational mandate is often noted as affecting the style in which adaptive management can be applied. For example, supporters of the modelling aspects of adaptive management stress that this type of management is only for situations in which a clear organisational mandate and centralised decision-making exist, i.e., where social system complexity can be effectively managed through the exertion of organisational mandate (Lee 1993a, 1999, Hunter

et al. 2003). Organisational stability and mandate also ensure stability during experimentation, adequate funding, and the memory required for adaptation. In situations where organisational mandate is less strong and where there is indecisiveness about management objectives between stakeholders, collaborative approaches to management that involve collectively reflecting on problem situations are more common (McLain and Lee 1996, Dovers and Mobbs 1997, Salafsky *et al.* 2001). In order that learning is valued, a non-conclusive ideology (i.e., one that is open to multiple hypotheses about system behaviour, and hence to trialling a range of management options) is paramount (Westley 1995, Haney and Power 1996, Salafsky *et al.* 2001).

Lastly, the state of a resource (for example, whether it is abundant, depleted or threatened) and its management history (for example, a history of conflict over management decision making) may also influence the practice of adaptive management. Titles such as *The path of last resort* (Light and Blann 2000a) suggest that in many cases adaptive management is not adopted until all other approaches have failed. This may be due to organisations reaching a stage where they are prepared to commit to and resource alternative approaches such as adaptive management (Gunderson and Holling 2002, Roe 2002). Management history also influences the trust of different stakeholders in both the leading institution and in the ability of science to support the management process (Lee 1993:106). In any case, an understanding of management and resource history will enable identification of potential barriers from previous management that could affect the capacity for practicing adaptive management.

2.3 Theoretical debates

Within the current practice of adaptive management, two discourses have emerged: (1) adaptive c*ollaborative* management, whereby differences in stakeholder perspectives can be mediated through the outcomes of management experimentation, and (2) adaptive *experimental* management, whereby the efficiency of identifying appropriate management solutions is optimised. Practitioners now often identify themselves and their projects as being concerned with or using one or other of the discourses. For example, the distinction of adaptive experimental management was used in a symposia title for the 3rd International Wildlife Management Congress held in Christchurch, New Zealand in 2004, and the Center for International Forestry Research has published work using the distinction of adaptive collaborative management (see Buck *et al.* 2001). The emergence of these discourses can be traced through different disciplinary developments. Rather than making assertions and concessions about the merits and limitations of the different disciplinary emphases, each

emphasis can be seen in light of a series of management costs that have the potential to exacerbate different contextual constraints.

2.3.1 Experimental and collaborative emphases

Carl Walters and Ray Hilborn (e.g.,Walters and Hilborn 1978, Walters 1986) have emphasised the use of models in adaptive management. In particular, they developed the notion of multiple competing system models and the application of Bayesian probability theorem[6] in determining the likelihood of a particular model representing the 'true' situation. Walters (1986) refers to this evolution of the adaptive management model as 'adaptive environmental assessment'.

The 'competing model' and an experimental emphasis are commonly linked. Emphasis on experimentation results in management that is applied as a 'treatment' in a scientific sense, with a clearly stated management hypothesis, management treatment area(s) (including the use of non-treatment areas) and replication for treatments (Walters and Holling 1990, Walters 1993, Lancia *et al.* 1996, Mangel *et al.* 1996, Parma *et al.* 1998). This emphasis has been favoured as a response to scientific arguments for more informed decision-making (e.g., McNab 1983, Carpenter 1990, Irwin and Wigely 1993, Steidl *et al.* 1997, Walter and Green 1997, Havens and Aumen 2000)[7]. Whilst Walters and Hilborn (1978) have contributed to developing adaptive management as a specialist oriented approach, this has arguably occurred to the point where the emphasis on optimisation of system outputs in adaptive management means its usefulness is limited to situations in which a singular common goal exits, rather than being used in situation in which management outcomes are unknown and desired outcomes debated.

A second emphasis of adaptive management comes from the field of policy studies. Lee's work (e.g., Lee 1993a, 1993b, 1999) builds on Holling's initial concerns about the need for interdisciplinarity in environmental assessment, in particular the need to develop socio-

[6] This theorem weights the value of different potential management outcomes by considering that the probability of any particular outcome arising from information collected is equal to the probability of a specific outcome multiplied by the probability of gaining data in relation to that outcome, divided by the sum of all probabilities of all outcomes multiplied by the probability of gaining data in relation to each of those outcomes (Hunter *et al.* 2003).

[7] Issues pertaining to large-scale experimentation such as that conducted via adaptive management (e.g., appropriate scale of interest, power, pseudo-replication, statistical analyses, indicator selection and statistical methods) are more specifically addressed in the ecological sciences literature (e.g., Walters and Holling 1990, Romesberg 1981, Hulbert 1984, Levin 1992, Walters and Green 1997, Sit and Taylor 1998).

political situations accepting of trial and error type management approaches and to address the social and institutional requirements of modelling and management experimentation. Lee (1993a) uses the metaphor of compass and gyroscope to argue that adaptive management requires a process of conflict resolution in order to reduce social uncertainty and enable the stability required for management.

Since the 1990s, issues pertaining to organisational and collaborative aspects of adaptive management have been identified as reasons for the few successes in its application (Lee 1999, McLain and Lee 1996). Importantly, there has been recognition that adaptive management requires cultural change in the way that organisations manage (Westley 1995, McLain and Lee 1996). This is rationalised in that the underlying worldview of less certainty is at odds with public demands of accountability and transparency in organisations, particularly state-sector organisations, and the expectations of science in delivering this. Adaptive management explicitly recognises that management organisations do not have the information they need to manage effectively, and therefore that the organisations and the affected stakeholders need to bring their collective wisdom in order to effectively learn how to manage for desirable ends. In order for adaptive management to be successful, organisations and stakeholders involved in adaptive management must be committed to the costs and time-frames of experiments used to underpin such learning (Holling 1978, Lancia *et al.* 1996, Walters and Green 1997, Light and Blann 2000a). As a consequence, they must also be committed to the potential risks that are posed in doing so, especially when experiments are designed to illicit more dynamic system behaviour (Walters 1986, Dovers and Mobbs 1997). Further, they must be committed to working together in a way which fosters agreement, innovation, team work, effective communication and information sharing (Lee 1993a, 1999, McLain and Lee 1996, Lessard 1998, Light and Blann 2000a, b, Jiggins and Roling 2000, Allen 2001b). Organisations and stakeholders must also have the capacity to be flexible and responsive to unexpected outcomes (Holling and Meffe 1996, McLain and Lee 1996, Lessard 1998, Dovers 2001).

Participation of multiple stakeholder groups (including specialists, policy makers, managers and other affected stakeholders) enables pseudo-institutions to be formed that recognise local knowledge alongside scientific knowledge and directly involve stakeholders in decision-making and direction setting. To this end, a number of useful theoretical links have been identified, including participatory research (Blumenthal and Jannick 2000, Allen 2001b), organisational learning (Allen 2001b, Salafsky *et al.* 2001), action research (Allen 2001b),

continuous improvement (Light and Blann 2000a), social learning (Salafsky *et al.* 2001) and traditional ecological knowledge (Berkes *et al.* 2000) to name a few. Emphasis on collaborative facets is particularly common in development cases where the livelihoods of the public are directly affected by management decision-making (e.g., Salafsky and Wollenberg 2000, Allen 2001b, Buck *et al.* 2001, Argumendo and Manen 2002, Oglethorpe 2002). This has resulted in an increased emphasis on community participation and institutional process as part of adaptive management (e.g., Roe 1996, Yaffee 1996, Dovers and Mobbs 1997, 2001, Cortner *et al.* 1998, Roling and Wagemakers 1998, Clark *et al.* 1999, Allen 2001b). In addition, collaborative techniques have been developed that support interdisciplinary perspectives on adaptive management. In particular, these have emphasised the development of conceptual modelling tools designed to enable stakeholders to move from inexplicit qualitative system depictions of socio-ecological systems to explicit depictions that can then be translated in a transparent manner into a quantitative model (e.g., Heemskerk *et al.* 2003, Lynham *et al.* 2002). This type of model can then be used as a basis for exploring different management scenarios and predicting the impact of management activities on system components identified as important by different stakeholder groups (e.g., Walkerden and Gilmour 1996, Salafsky and Wollenberg 2000, Wollenberg *et al.* 2000b, Bunch and Dodycha 2004).

The development of different emphases is a natural progression in the evolution of adaptive management given that it enables links between like-minded practitioners. However, it can equally be argued that debate about the practice of adaptive management from the auspices of disciplinary based discourse is itself limiting practice. A lack of integration of developments may lead to situations in which the needs of a given context are considered secondarily to the interests or values of practitioners. Instead, different contexts can be viewed as creating conditions that limit the potential usefulness of different emphases and ways of operationalising adaptive management.

2.3.2 Variants on the basic process

Pertinent to many discussions of adaptive management is a distinction between the 'passive-adaptive management' (PAM) and 'active-adaptive management' (AAM) operational models, first made by Walters (1986). Two distinctive forms of AAM now referred to in the literature are presented in conjunction with PAM in Figure 2.3.

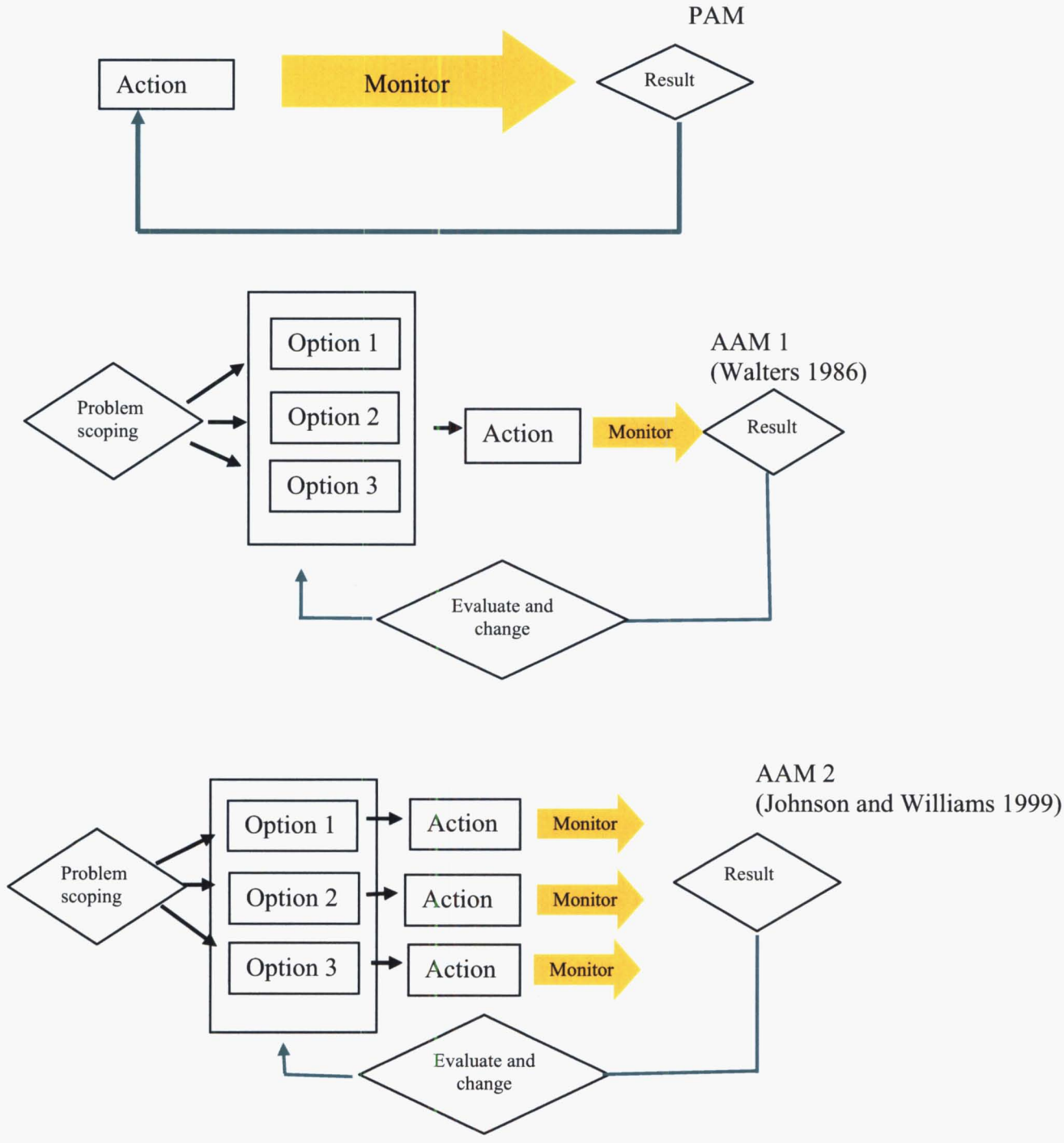

Figure 2.3: Passive-adaptive (PAM) and Active-adaptive (AAM1 & AAM 2) management models. Note that the process model (Figure 2.1) presented at the beginning of this chapter is synonymous with models of AAM.

PAM is normally associated with a cyclical plan, act, monitor and assess process in management, and is commonly confused with trial and error approaches (Wildhere 2002). These two forms are distinguishable in that trial and error management does not link

monitoring of management actions to their subsequent adjustment, and thereby management changes are made based on socio-political response or wisdom (Johnson 1999). MacDonald *et al.* (1997) suggest PAM is suitable for situations where experimental design is difficult, too costly or too risky, or where there is strong management option preference. However, its weaknesses include a lack of discrimination between different options for achieving management goals (*ibid*), a lack of ability to show cause and effect (Wildhere 2002) and the confounding of management and environmental effects[8] (Walters and Holling 1990). In response to the weaknesses of PAM, Walters (1986) suggested active-adaptive management as an alternative.

Walters' initial model of AAM involved the development of multiple mathematical models of an ecological system from existing data, enabling predictions to be made about the outcome of a range of different management options, from which one would be implemented, monitored and assessed (Walters 1986). This model of AAM is still limited in that whilst it simulates the effects of various management options and hence avoids unnecessary costs and risks associated with experimentation, it still only tests one management option. Further, as Schreibner *et al.* (2004) have noted, Walters' model of AAM, which he referred to as adaptive environmental assessment, differs from current conceptions of AAM.

AAM, as described by Johnson and Williams (1999), differs from that of Walters' (1986) in that it includes experimentation with multiple management options (Schreibner *et al.* 2004). In this case, considerable skills are required for modelling and experimental design, and hence the result is likely to be an expert driven management process. The financial, opportunity and socio-political costs associated with this model may be reasons why it has been suggested as ineffective outside of a single agency with a monopoly on land-access and decision-making (Lee 1999, Hunter *et al.* 2003)[9]. AAM of this form is still discernable from science in that it answers questions more relevant to management, is large rather than small scale, is

[8] An example of this is from salmon fisheries in which decreasing salmon farm stocks were considered a response to warmer ocean temperatures, until comparison with natural populations (which would not have occurred under PAM) did not follow similar trends. In this case, the loss was due to an interaction effect between management and the environment, whereby warmer oceans led to disease outbreaks that were only able to spread because of the close proximity of fish to each other that occurred in the hatchery (Walters and Holling 1990).
[9] Interestingly, Roe and van Eeten (2002) and Roe (2002) argue that adaptive management is best suited for ecosystems with human colonisation but not full domination (e.g., national parks), given that there tend to be multiple resources with few uses, a less adequate scientific understanding and low levels of resource extraction. In such cases, organisational mandate tends to be clearly identified in legislation. This analysis may therefore explain the noted observations.

empirically tested in the field situation and gains its credibility from practitioners before scientists[10].

Differences between these three models of adaptive management, laboratory science and trial and error management can be represented on a continuum, against which management concerns can also be depicted (Figure 2.4). Some context concerns appear to be substantially more significant when applying management under a trial and error framework, while others appear substantially more significant under a more experimental framework.

The outcome-orientation of management is often perceived to be higher in situations where management change is more incremental and less concerned with identifying the non-linear nature of system behaviour as in AAM (Walters 1986). Any gains made under trial and error management are akin to educated guesses with an increased likelihood of ineffective management. Similarly, support for management is likely to remain reasonable given that stability is generally preferred by people who rely on system resources (Roe and van Eeten 2002). Alternatively, the rigours of experimentation may provide substantial long-term gains that appeal to a greater audience (i.e., increased chance of identifying effective management regime) by testing assumptions about the nature of interactions within an ecological system and exposing unconsidered interactions (Walters 1986, Schreibner *et al.* 2004). Institutional costs (e.g., financial) are greater under experimental management. Increased risk of unknown outcomes may expose systems (and managers) to unpopular management consequences (Peterson *et al.* 1997, Walters 1997) and is therefore likely to limit local support for management even though it is likely to increase efficiency and effectiveness of learning and management in the long-term (Walters 1986).

[10] These characteristics are similar to what Funtowicz and Ravetz (1994) suggest are a necessary transition for research that supports environmental management, and which they refer to as post-normal science. Hence, adaptive management may be seen as science colonising management, but the nature of 'science' has not escaped being changed in the process!

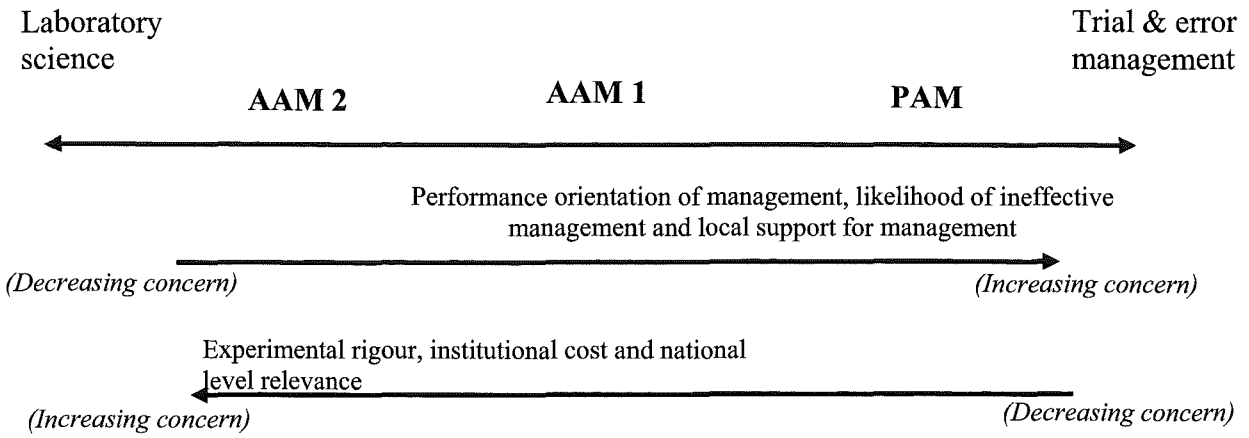

Figure 2.4: Outline of the constraints of various models of adaptive management. Models of adaptive management presented are those outlined in the text. Arrow direction represents an increase in the specified management concern (as indicated).

Arguments have been made about the compatibility of particular models of adaptive management with certain contexts (e.g., Lee 1999, Roe and van Eeten 2002, and Jiggins and Roling 2002, Hunter *et al.* 2004). For example, Lee (1999) argues that adaptive management is limited in situations where conflict over decision preference is unresolved. What is not clear in these arguments is whether particular models really are inadequate, or whether they were not attempted in a way that adequately addressed socio-political concerns relating to the management context. In answer to Lee's concern (*ibid*), this is to suggest that there may be situations in which collaborative approaches that support conflict resolution (for example soft systems methodology) are combined with experimental discourse to produce a management process more reflective of contextual constraints.

The desire to attract experts to adaptive management and its science roots are potential reasons for the common tendency of its practice to be experimentally driven, i.e., focussed on problems to be 'solved' rather than focussed on exploring of messy situations for which solving problems is secondary to reaching agreement on the nature of the problems themselves (Lee 1999). Whilst including some participation, an experimentally driven process commands goal consensus and hence does little to address conflict (Lee 1999) nor does it consider the way in which adaptive management can be used to address assumptions associated with particular view-points on management, i.e., the potential for individual learning and change that occurs because of participation. Participation of a wider range of stakeholders in more significant parts of project management may however result in challenges to the traditional role of experts in conducting 'science' by suggesting that experts

are not alone in having the ability to generate meaningful knowledge (as Anyanwu (1988) argues). Further, it may result in the politicising of the scientific process and the failure to achieve the management objectives at hand (Brower *et al.* 2000).

2.3.3 A reflexive turn?

The development of a range of emphases in the practice of adaptive management has resulted in either very generic guides for practice (e.g., Holling 1978, MacDonald *et al.* 1997, Light and Blann 2000a, Buck *et al.* 2001, Salafsky *et al.* 2001, Meffe *et al.* 2002) or multiple and sometimes incongruent definitions (see Light and Blann 2000a for examples of these). Some clues are provided as to the effect of this on the support for and use of adaptive management. In a review of the U.S. Department of Agriculture Pacific Northwest Research Station Adaptive Management Areas programme, Duncan (2001:5) states that adaptive management was never clearly defined and suggests that a lack of shared meaning of the approach has "...tended to divide the already thin ranks of supporters". Further, Roe and van Eetens' observation that the definition and interpretation of adaptive management is dependent "...on location, profession and professional paradigm" (Roe and van Eeten 2002:512) adds weight to the argument that ensuing criticisms of the approach might be expected. Concerns about the practice of adaptive management from the likes of Parma *et al.* (1998:17) who state that "...adaptive management is now a buzzword, commonly confused with an ad hoc trial and error approach to management under uncertainty, as in 'action first, science later'" provide evidence of such criticism. These criticisms are supported by others including Wildhere (2002) who comments that adaptive management is often misunderstood when planned for, and what Duncan (2001:4) describes as the "...rhetoric of AMAs [adaptive management areas] and adaptive management as 'new ways of doing business' that in fact its more like 'business as usual'". These criticisms have the potential to challenge the foundations that alternative approaches to environmental management are based on as well as the support for them.

An emphasis on blanket descriptions of 'proper' and 'improper' practice of adaptive management (amended by the various paradigmatic discourses) has obviously, in part, led to a lack of support for uptake of adaptive management in general practice. In order to improve the practice of adaptive management, and increase the support for it, there is a clear need for reflection on collaborative and experimental perspectives as they relate to the context of management. A recent analysis of adaptive management within Australian natural resource management organisations (Allan 2004) supports this argument.

2.4 Towards a reflective model of adaptive management

In order to build reflection on adaptive management, an understanding of the links between adaptive management and learning theory is first needed. For the purposes of this thesis, learning is defined as the potential for action based on previous experience. A range of theories exists about the process of learning. Traditionally, learning has been seen in light of the behaviourist model, whereby learning is dependent on conditioning. Alternatively, cognitive, constructivist and humanist approaches espouse that behaviour can be learned through the observation of others, giving rise to the notion of social learning, i.e., learning from interaction with others (Keen *et al.* 2005). A key point of difference between behaviourist and other theories of learning is that the latter allow for a process of reflection, i.e., the internalised consideration of experience (Reynolds *et al.* 1996, Ison *et al.* 2000).

Alternative approaches to learning have focussed on the process of reflection. Alternative theories emphasise that the learning experience is one that initiates an internalised process of structuring new knowledge within existing knowledge structures or schema (Reynolds *et al.* 1996, Ison *et al.* 2000). As Maturana (1978) notes, each individual is coupled to an environment. What is learnt is therefore dependent on the external environment, the process of cognition and the individuals themselves. The ability to support reflection therefore depends on the environment in which information is provided. Constructivist theories have further attended to the active involvement of both information provider and recipient in the process of making meaning of new information. More recently, humanist learning theorists (see Blackburn 2000) have challenged the power relations associated with learning, placing learners in control of information and processes that lead to reflection and behaviour change (Atherton 2006). Together, these learning theories are significant to adaptive management in that they enable the model of adaptive management developed earlier in this chapter to be reconsidered as a learning schematic. They are also significant when considering ways to support the practice of reflection.

Descriptions of reflection as part of the learning process commonly depict three levels. Table 2.1 presents different depictions of these levels, contrasting them against descriptions of PAM and AAM presented in the previous section. Thus, adaptive management can be considered analogous with other learning processes. Stripped bare of context, adaptive management represents an adaptive learning process where observations are not only internalised, resulting in a reassessment of objectives, assumptions and goals, but also the actions they form the basis of. The diversity of fields of practice and authors presented in this table are by no

means exhaustive, but they do demonstrate the convergence of theories, thereby providing a useful reference point from which to consider reflection as part of the adaptive management process. The levels in the left hand column represent those used within the remainder of the thesis.

Table 2.1: Levels of learning corresponding to levels of reflection identified in some different fields of practice

	Education	Education / cybernetics	Organisational learning		Adaptive Management
Authors	Moon (1999; 2004)	Bateson (in Harries- Jones 1995, and Atherton 2005)	Senge (1990)	Argyris (1990)	
0 Not learning	Noticing (identifying concepts)				Trial and error
1 Reflecting on action	Sense making (Linking concepts)	Learning I (1st order cybernetics)	Reactive (Visioning)	Single loop (correcting mismatch between aims and outcomes)	PAM
2 Reflecting on assumptions	Meaning making (Accommodating new concepts into schema)	Learning II (2nd order cybernetics)	Responsive (Models)	Double loop (reflection on action)	AAM 1 & AAM 2
	Working with meaning (Using new information purposefully)				
3 Reconsideration of problem	Transformative (Reconsideration of schema)	Learning III (Learning about the context of learning, or Inter-relationships between 1st and 2nd order feedback through space and time)	Generative (Systems thinking)	Deutro learning (reflections on patterns of learning)	Few explicit links

Using the levels of reflection outlined in Table 2.1, the adaptive management process model introduced earlier in this chapter can be represented as a learning schematic (Figure 2.5). In this figure, PAM involves only level one reflection, whilst the various forms of AAM achieve both level one and two. Aside from the comments of Light and Blann (2000a) on the need to consider the appropriateness of goals, given changes in understanding the management system, discussion of level 3 reflections is largely missing from the adaptive management literature.

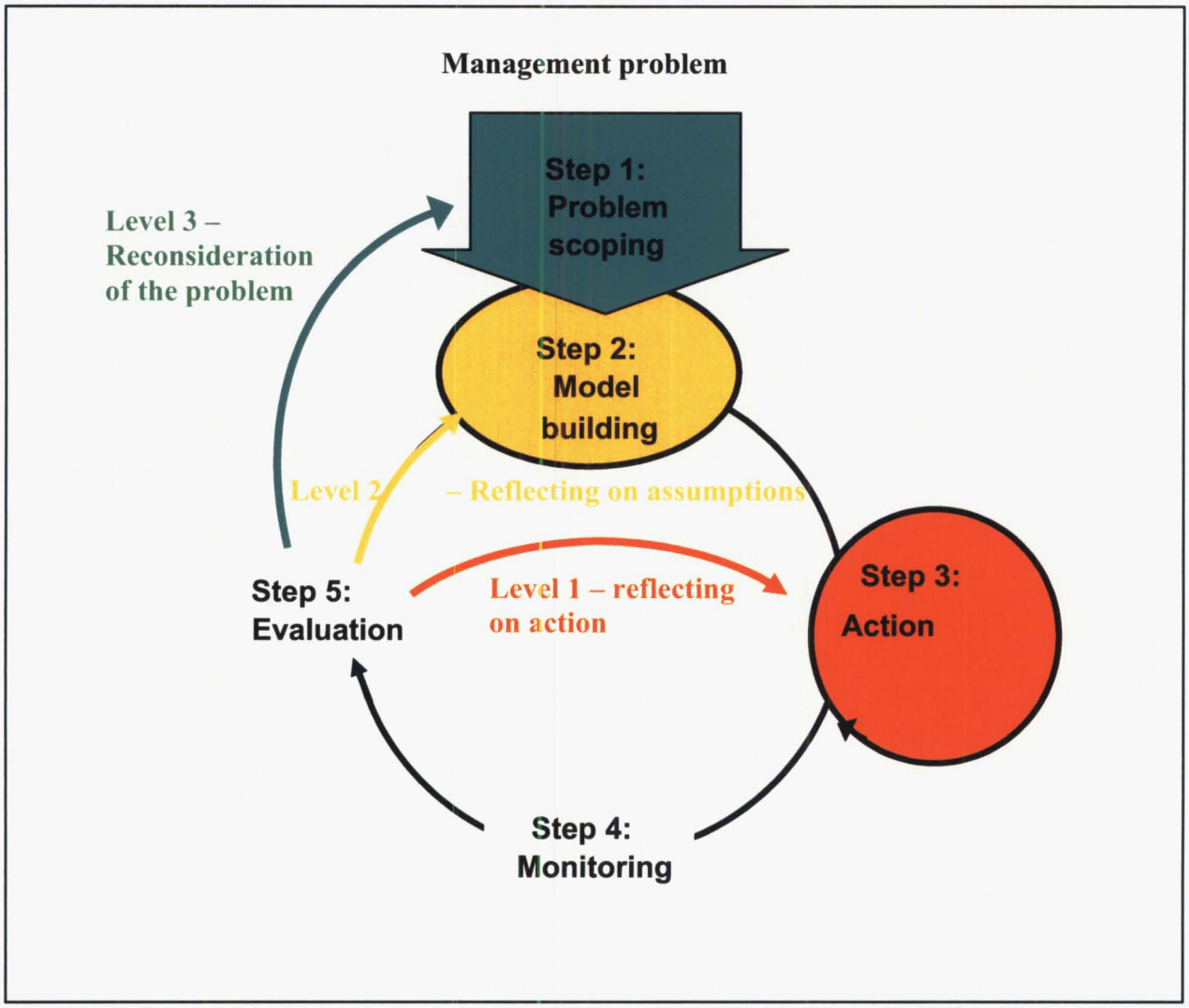

Figure 2.5: Three potential levels of reflection in the adaptive management process

Building capacity for adaptive management requires emphasis to be given to building depth of reflection from level one to level three. Evidence of level one reflection comes from linking the outcomes of planned action to their design. For example, an individual might seek to answer 'is there more evidence for, or against the hypothesis?' Evidence of level two reflections comes from reassessing predictions about the outcomes of particular action and why they were different from or similar to that expected. For example, an individual might

seek to answer 'what is the significance of the different discourses on adaptive management?' Evidence of level three reflections comes from reconsideration of the appropriateness of goals and the particular problem they aim to address or the reasons that give justification for assumptions. For example, an individual might seek an answer to 'is the goal of this project an appropriate one?" and 'why is that the case?'

In order for organisations to be capable of reflection and change, Argyris (1990) lists five key assumptions that must be met. These are: (1) that individuals can identify inconsistency or incongruence in practice, (2) that they want to change, (3) that they have the skills to change, (4) that they can identify alternative practices and (5) that potential changes in practice are possible. Similarly, Moon (2004) argues that the decision to undertake learning, and subsequently the content of what is learnt, is influenced by the individual. Further, Moon (*ibid*) suggests that the level of reflection achieved is influenced by a range of factors, including the conception of the learning process, prior experiences, perceptions of the demands of learning (e.g., time and emotional commitments) and aims associated with the learning task. As noted by Shon (1987), reflection can lead to one of two outcomes: (1) that the subject of learning is considered 'too hard' and hence the learner has not been taught the appropriate material (a defensive strategy); or (2) that the learner chooses to confront the challenge presented and hence that they own the outcomes of learning (irrespective of the role of a facilitator in reconciling the challenge).

The task of facilitating reflection is not an easy one. Senge (1990) emphasises the need for leadership in organisations, suggesting the role is one that includes roles of designer, teacher and steward. Alternatively, Argyris (1990) argues for the facilitated recognition of espoused theory of practice, and 'theory in use', identifying how 'theory in use' is maintained, and the provision of new potential theories. He further suggests that individuals commonly respond to such challenges with a socialised form of defensive behaviour which tends to support unilateral control, fulfil the status quo, avoid negative emotion and maximise 'wins'[11]. This sentiment is further exemplified in his discussion of trust involved in the learning process, "in order to produce trust, individuals must entrust themselves to others, they make themselves vulnerable. Before they are willing to take such action, they must examine...their fears about designing their own vulnerability" (*ibid*:70). The need for facilitated learning in order to build

[11] It is worth noting here that the empirical evidence presented by Argyris (1990) comes from business organisations in the USA (typically male dominated) and hence the behavioural responses identified may not be as apparent in different types of organisations and in different countries, including those described in Chapter Four.

reflection is also supported in the educational literature, where the educator's role is not one of information provision, but the provision of guidance, support and challenge (in reducing levels) as groups of 'inquirers' are able to deepen their reflections and do so without support from the facilitator/teacher (Moon 1999, 2004).

Clearly, there is a key role for facilitation of reflection in presenting inconsistencies, incongruencies and complexity in order to support the first of Argyris's (1990) assumptions. There is also a role in supporting the identification of achievable alternatives. The key challenges in facilitating reflection on adaptive management involve understanding the characteristics of facilitation tools, project context, and the individuals that both inhibit and enable different levels of reflection.

2.5 Approaches for building reflection on adaptive management

The argument for more reflective use of adaptive management as appropriate to context requires consideration of how that support for reflection is best provided to practitioners. The use of reflection building approaches addresses the second of the two key aims, i.e., to develop understanding about the potential contribution of reflection building approaches to supporting the adoption and practice of adaptive management. In this thesis, three different approaches have been used to support reflection. Approaches used include formative evaluation, group inquiry and individual reflection on group process. The selection of approaches and their application was based on four criteria (presented below). These criteria can be thought of as relating to the intersection of two issues: my own personal research interests (criteria one and two) and case-study access (criteria three and four). The criteria were:

1) Tools I thought might be useful in contributing to theoretical understanding of adaptive management (based on a prior comprehensive review of the literature);
2) Activities I perceived as beneficial to participants (based on a review of case material, previous research cycles, or a combination thereof);
3) Participants' perceived 'usefulness' of the approach; and
4) Constraints on involvement (i.e., time and financial commitments of participants and research).

Thus, whilst I had an initial legitimated interest in developing participatory evaluation as a tool for addressing the apparent dichotomy in the discourses of adaptive management identified earlier in this chapter, access issues affected my ability to do so with particular

cases. Use of alternative approaches in addition to formative evaluation was therefore considered necessary and the research approach itself was adapted. The approaches used to build reflection in the thesis are detailed in the chapter subsections that follow due to the significance of identifying linkages to both adaptive management and the task of reflecting on it outlined earlier in this chapter.

2.5.1 Formative evaluation

Evaluation of management projects serves at least three purposes: (1) an assessment of project outcomes in relation to goals (i.e., for the purpose of accountability); (2) identification of mistakes or problems in order to enable improvement; and (3) identification of successes in order to motivate (Gujit 1999, 2000). Evaluation has traditionally been conducted in a summative fashion, whereby projects are assessed in relation to a set of predetermined criteria that enable the attainment of goals to be quantified (Shadish *et al.* 1991), emphasising project accountability (Sechrest and Figuerdo 1993, Duignan 2002). However, whilst this is sufficient for reflecting on the first of the three purposes identified, critics of the summative approach have argued that the use of predetermined criteria might favour the perspectives of the evaluator (Sechrest and Figuerdo 1993), is less likely to consider others' (including participants') goals, and may be perceived as having limited utility if conducted from outside of an organisation, given that an outsider may be less likely to be able to identify issues affecting the ability of an organisation to meet its goals (Leviton and Hughes 1981, Fetterman 1999, O'Sullivan 2004). Irrespective of the intent of achieving 'independence', summative evaluation conducted by external evaluators has also been challenged due to their inability to empower participants to reflect on their own situation, and therefore to win support for subsequent organisational change recommendations (Patton 1987, Shadish *et al.* 1991, 2001).

The use of summative and independent evaluation of adaptive management projects requires clear definitions of criteria for practice that are not necessarily grounded in the practice context. Further, the previously noted paradigmatic interpretation of adaptive management means that summative evaluation is likely to be inherently limited to the perspectives of the evaluator, funding agency or scientist involved. Technical and lengthy descriptions of adaptive management (and subsequently derived evaluations) may remain inaccessible to managers because of their detail or use of technical language. Therefore, they may also be perceived, as noted by Roe (1998), as bureaucratic involution that serves to enforce the need for specialist direction, rather than achieving a greater purpose, namely that of building

capacity to learn. Hence, the value of summative evaluation to address the concerns about the separation of collaborative and experimental emphases of adaptive management, and the lack of reflection on the context of practice, is limited.

Formative evaluation is commonly heralded as building capacity to support change (Roling and Jiggins 1998, Gottret and White 2001). Formative evaluation encompasses multiple forms, from participatory evaluation to collaborative evaluation (O'Sullivan 2004), and may itself make use of summative techniques, for example, rating or quantifying management variables (e.g., Kilvington and Allen 2001). Participation in evaluation is crucial and helps to ensure credibility (Fetterman1999), relevance to context (McAllister and Vernooy 1999, Gottret and White 2001) and integration within the policy and decision-making context (Shaddish *et al.* 1991, Gujit 1999). Further, by allowing for participation in the design of evaluation criteria, their relevance is assured. Participation in project assessment also enables opportunity for discussion and reflection on the management context of a project (Gujit 1999, 2000). Thus, the benefits to participation are traded against the potential weaknesses of self-promotion by participants. In cases where confidentiality is not assured or individuals do not value learning, formative evaluation may not be completely successful in identifying failures and exploring reasons for them (*ibid*).

Support for formative evaluation frameworks within adaptive management is evident and includes work associated with high-country grasslands (Allen 1997, 2001) and forest management (Shindler *et al.* 1999). These works address group process, and citizen agency interactions (respectively) within adaptive management, highlighting the value of evaluation for improving the practice of adaptive management. The benefit of this form of evaluation for adaptive management is that it enables reflection on a range of indicators (i.e., from both collaborative and experimental emphases of adaptive management) that can contribute to the identification of factors that support and limit successful adaptive management within a given context.

Participatory evaluation has traditionally been applied as a way for groups to build and use their own criteria to evaluate a project they are involved in (Gujit 2000). This thesis is based on the assumption that 'other aspects' (i.e., social) have been neglected. The use of this style of formative evaluation does not necessarily negate this concern. Participation does however offer opportunity to ensure that language is relevant to those involved; that context (and its

effects on the relevance of evaluation criteria) is considered; that reflection on less considered aspects is supported; and that reflection on contextually derived issues is provoked.

Central to the use of formative and participatory evaluation is the use of questions that ellicit reflection (Weiss 1995). First and foremost, there is a need to outline why the evaluation is important (Gujit 1999). Secondly, question types should address the needs of the management process, the structure of it and the resources required (Shadish *et al.* 1991, Duignan 2002). The process of evaluation used should also enable judgement and the identification of strengths and weaknesses in management (Beyer 1995, Gujit 1999), and enable assumptions supporting choices to be identified (Weiss 1995). Further, rather than an extensive list, some issues are fundamental whilst others are more peripheral, as is illustrated in an evaluation of 30-years of research in organisational learning by Eastoby-Smith *et al.* (2004).

An evaluation framework for adaptive management

The approach used in this thesis has therefore been to develop an evaluation framework that could be used as a starting point for a participatory evaluation. This included four steps:

1. Criteria for adaptive management (including both collaborative and experimental perspectives) derived from review of the literature;
2. Adjusting criteria based on the way adaptive management is framed in the New Zealand conservation context;
3. Adjusting criteria based on the usefulness for evaluating the practice of adaptive management, and turning these into questions; and
4. Testing the usefulness of questions to ellicit reflection on both social and ecological aspects of practice.

This model best fits that of Practical Participatory Enquiry, as described by Cousins and Whitmore (1998), whereby evaluation offers the opportunity of support for decision-making and problem solving, and through participation, ensures utilisation. From the review of literature completed in this chapter, I was able to identify 82 criteria that are important in the practice of adaptive management. These criteria are organised into four sections: learning, process, implementation and evaluation. The criteria and their justification follow. Note that this number of criteria might be considered excessive for an evaluation, and in some cases, repetitive or overlapping. They are presented here, given that they represented my

interpretation and understanding of adaptive management at this particular stage of research development.

Learning

The learning process in adaptive management is involves formal evaluation of management objectives and assumptions supporting them (Taylor *et al.* 1997, Lessard 1998, Light and Blann 2000a). If management is to be truly reflective, as Kelly *et al.* (1999) and others (e.g., Allen 2001b, Allan 2004) argue is necessary, then the appropriateness of goals must also be assessed (Light and Blann 2000a). The creation of benchmarks provides a useful means of doing so (Salafsky *et al.* 2001). Failures must also be treated as learning experiences, and an incentive for collective learning is needed, given the investments required in adaptive management (Jiggins and Rolling 2000, Salafsky *et al.* 2001). Underlying the need for learning is a world-view that recognises knowledge as temporary (Holling *et al.* 2001) and the behaviour of systems as dynamic (Kelly *et al.* 1999). Idealogically, practitioners must be open-minded (Westley 1995), recognise the implications of choosing different methods for learning (Shrader-Frechette and McCoy 1994) and be prepared to work in a new way (Light and Blann 2000b). Twelve of the 82 criteria addressing this aspect of adaptive management are presented in Table 2.2.

Table 2.2: Criteria relating to learning	
Double loop learning	1. Assumptions evaluated 2. Assessment of wrong goal 3. Promotes reflection and leads to innovation 4. Formalised double loop learning process 5. Benchmarks for success created
Experiential	6. Failure treated as learning experiences 7. Collective learning
World-view	8. Recognises knowledge as temporary 9. Recognises the effect of value judgements on methodological choice 10. Ideologies are non-conclusive 11. Recognises the dynamic behaviour of systems 12. Transcends assumptions and paradigms that are barriers to learning

Process

Central to the collaborative emphasis of adaptive management outlined earlier in this chapter is a focus on process. The active involvement of a range of different stakeholders in adaptive management (including policy makers, managers, scientists and other affected stakeholder groups) requires a structured and formalised process in order that different groups (often with opposing perspectives) are capable of working together (Dovers and Mobbs 1997, Horsfield

1998, Salafsky *et al.* 2001). Decision making processes must be agreed to, and management adjustment mechanisms pre-planned to avoid fall-out at later project stages (Dovers and Mobbs 1997, Taylor *et al.* 1997, Lessard 1998). A range of outcomes is required from the collaborative process, including an ability to build trust (Light and Blann 2000a) to address conflict between different stakeholders (Lee 1993a), and to work in an interdisciplinary way (Taylor *et al.* 1997, Jiggins and Rolling 2000). Skilled facilitation is required to promote co-operation between different stakeholder groups (including different organisations) and to provide information from a range of sources that addresses stakeholder needs (Johnson 1999b, Lessard 1998, Lee 1999). As a result, a shared understanding of a management problem can be built (Salafsky *et al.* 2001, Allen 2001). Fifteen criteria addressing this aspect of adaptive management are presented in Table 2.3.

Table 2.3: Criteria relating to process	
Participation	13. Includes a range of affected stakeholders in the design of the management process 14. Actively involve stakeholders 15. Structured and formalised process
Process issues	16. Decision making processes are agreed to 17. Agreed management adjustment mechanisms are pre-planned
Collaborative Management	18. A structured collaboration process 19. Address conflict between stakeholders in order to build consensus 20. Fosters communication 21. Supports interactions that build trust 22. Develops a shared understanding of the management problem 23. Facilitation skills are utilised 24. Promotes co-operation between stakeholder groups & organisations 25. Explores and addresses informational needs 26. Identifies a range of relevant information sources (e.g., scientific, local and indigenous knowledge) 27. Addresses problems in an inter-disciplinary way

Implementation

The implementation of adaptive management requires goals to be formed in order to provide direction for management and a point of reference for evaluation and possible modification when new knowledge has been gained. Whilst goals form the entry point in a rational planning approach (Mitchell 1997), the specificity of goals in adaptive management often occurs through the development of models. If adaptive management is to avoid unexpected problems during or after implementation, the goals setting should include stakeholders in the quest for long-term learning (Allen 2001b, Walters and Hilborn 1978). A balance of goals and overall vision for a system is also important, given the need for focus in adaptive management, and therefore goals should support this (Light and Blann 2001a). A desire to

learn is central to adaptive management (Lessard 1998). Goals should also be more holistic than narrow in focus (Holling and Meffe 1996), target understanding of cyclical processes, i.e., less regular ecological events (Holling 1995), and manage for performance range rather than a fixed target, given that uncertainty is acknowledged and flexibility is necessary (Johnson 1999b). Clear management boundaries are needed to ensure an appropriate target system for management implementation (Jiggins and Rolling 2000). Goals should include an emphasis on building system resilience (Gunderson *et al.* 1995), improving capacity to manage as opposed to just performance (Johnson 1999b), and should include social objectives (Dovers and Mobbs 1997).

The use of models in adaptive management, as previously noted in this chapter, can serve as a method for identifying knowledge gaps and uncertainties (Taylor *et al.* 1997), structuring debate (Lee 1999) and for exploring leverage points in systems being managed (Salafsky *et al.* 2001). Because no model is perfect, assumptions and uncertainties must be made explicit and acknowledged (Taylor *et al.* 1997). The development of a model requires the use of indicators in order to avoid being overly complex (Johnson 1999b), must address both temporal and spatial scale of the system under management (Light and Blann 2000a) and, if it is to be used in decision making, it must be translatable for a non-science audience (Jiggins and Rolling 2000).

Management options should be formulated as hypotheses about system behaviour so that they are testable, and supporting assumptions should be clear (Horsfield 1998). Decisions about which options to implement need to involve those who are likely to be affected by them (McLain and Lee 1996), to be driven by ecological imperatives so that meaningful timeframes are considered (Light and Blann 2000a) and to consider policy perspectives (Dovers 2001). In order that irreversible risk is avoided, risk should be assessed (Lee 1999). Thus, uncertainty about effects of specific choices must be recognised (Lee 1999), trade-offs documented (Taylor *et al.* 1997) and irreversible risk avoided (Christensen *et al.* 1996). Cost-benefit analysis provides a useful tool to identify risks (Horsfield 1998). In adaptive management, management actions with lower outcome uncertainty are favourable (Light and Blann 2000a). However, risks may be justifiable if they increase system understanding (Walters 1986, Lancia *et al.* 1993). In any case, risk taking should be a qualitative decision since affected stakeholders bear the costs of any unlikely outcomes that occur (Walker *et al.* 2002). Transient solutions may be necessary where risks (including stakeholder conflict) are high (Light and Blann 2000a). Decisions must thus allow for a degree of flexibility (Holling 1995).

Given that the implementation of management actions in adaptive management is designed to improve learning, they should be implemented as experiments (Holling 1978). Thus, policy choice must be recognised as being experimental (Walters and Holling 1984). The purpose of learning is for management (rather than for its own sake). The focus is therefore on the use of the appropriate science (Taylor *et al.* 1997), biological significance (Johnson 1999b) and avoiding type two error, i.e., failing to detect a response when it exists (Taylor *et al.* 1997). When working with large systems where few independent replicates may exist, there is also a need to accept compromise and constraint in the design of management as an experiment (McLain and Lee 1996). Management implementation therefore encompasses issues relating to goals, decision-making, modelling, planning and implementation. The 42 criteria outlined in Table 2.4 address this section.

Table 2.4: Criteria relating to implementation	
Goal setting	28. Involves stakeholders 29. Aim for long-term learning 30. Balances vision and goals 31. Holistic focus 32. Designed to develop understanding about cyclical processes 33. Manages for a performance range not a fixed target 34. Clearly defined boundaries of management 35. Include social objectives 36. Include a desire to build resilience 37. Include a focus on improving capacity rather than just performance 38. Goals tailored to increasing understanding of the system
Model development	39. Assumptions in model are made explicit 40. Uncertainties in model are acknowledged 41. Knowledge gaps are identifiable 42. Key indicator species and processes are identified 43. Avoids over-parameterisation 44. Useful as a tool for identifying leverage points in systems 45. Development process used as a means of structuring debate about management 46. Addresses issues of scale – both temporal and spatial 47. Must be translatable for policy makers and non-science audience
Option development	48. Management options or policies formulated as testable hypotheses about system behaviour 49. Assumptions supporting hypotheses are explicit
Decision-making	50. Decisions are not rigid and inflexible 51. Trade-offs are documented 52. Risks are assessed 53. Cost benefit analysis is considered 54. Transient solutions are accepted 55. Stakeholders are involved in the process 56. The process is driven by ecological imperatives 57. Actions with less uncertain outcomes are favoured 58. Policy imperatives are given parity to economic ones 59. Uncertainty is recognised 60. Irreversible risk is avoided 61. Risk taking is guided by values rather than probabilities 62. Risks are justified if they strengthen system understanding
Planning and implementation	63. Management actions are designed and implemented as experiments 64. Policy choice is recognised as experimental 65. Getting the science right is second to getting the right science 66. Focus given to minimising type two error rate 67. Biological significance emphasised 68. Compromise and constraint accepted 69. Response time-lags considered

Monitoring and evaluation

The emphasis of adaptive management on learning also necessitates systematic and planned monitoring and evaluation (Haney and Power 1996). Long and short term responses to management should be considered in order to identify both 'normal' and 'less normal' responses to management actions (Johnson 1999a). The use of five to ten key indicators

avoids unnecessary complication in data analysis and reduces costs (Holling 1978), whilst the involvement of the community can help to provide trust in the data and continued project involvement (Bosch *et al.* 1996). Evaluation, using monitoring data, must be conducted in a systematic way, addressing goals and objectives of management (Holling 1978, Salafsky *et al.* 2001). In doing so, lessons are documented ensuring transparency of the management process and allowing its success to be assessed (Boyce and Haney 1997, Lessard 1998, Salafsky *et al.* 2001). During evaluation, practitioners of adaptive management must be prepared to be self-critical to ensure learning occurs (Dovers 2001). Traditional annual evaluations may be inappropriate in adaptive management given that experimental timeframes are tailored to ecological processes, for example, the period of time likely to be needed to measure a response to management actions (Holling 1978). Thus, different approaches to evaluation can be trialled (Light and Blann 2000a). Monitoring and evaluation provide a crucial step in adaptive management, enabling revision of goals, system understanding, reconsideration of the management problem and iteration in learning. Table 2.5 includes 13 criteria related to monitoring and evaluation. These evaluation criteria and their organisation have been successively refined in subsequent cycles of research, details of which can be found in Chapters Five to Seven.

Table 2.5: Criteria relating to monitoring and evaluation	
Monitoring	70. Monitoring is planned for and conducted in a systematic way 71. Short and long-term responses are measured 72. Indicators are used 73. No more than 10 indicators / measures 74. Community is involved
Evaluation	75. Analysis is conducted in relation to goals and objectives 76. Lessons are documented 77. The process is transparent 78. The success of management processes are assessed 79. Evaluation is conducted systematically 80. Timing of evaluation matches the scale (i.e., temporal) of ecological processes 81. Practitioners and their respective organisations and groups are self-critical 82. Different approaches to assessment can be trailed

In developing these criteria, I had anticipated that they would need to be refined to a smaller number that provided an appropriate degree of relevance for evaluation, and then turned into questions for use as part of a formative and participatory evaluation exercise. I had also hoped to use the same group of cases to both refine and test the framework with. However, a lack of interest and commitment from the cases with which the criteria were refined (see Chapter Six) resulted in consideration of other cases and approaches to supporting reflection on the practice

of adaptive management. I continued framework development with an alternative group of cases. However, I did not want to ignore the potential benefits of building reflection on the adoption and practice of adaptive management with the first group. In order to reduce the level of commitment required to the research, I focussed my attention on reflection building approaches that could be applied to specific parts of management. This resulted in additional literature syntheses.

2.5.2 Joint inquiry

In order to build reflection, many authors argue for the use of group-based inquiry. Shon (1987) suggests that joint inquiry can provide opportunity for building reflection needed for learning. This notion of a small-group, task oriented learning exercise is further supported by Ison *et al.* (1997) who provide details about how group inquiry can act as an exemplar for bottom-up organisational change. Heron and Reason (2001) argue that group inquiry attends to the weakness of standard research extension whereby "there is little connection between the researcher's thinking and the concerns and experiences of the people who are actually involved" (*ibid*, 179). Thus, joint inquiry acts as a mechanism for sharing different conceptualisations of management practice.

Within the fields of action research, 'joint' inquiry has developed into a more specific form called co-operative inquiry. In order to distinguish co-operative inquiry from other forms of research, Heron (1996) states that co-operative inquiry involves democratisation of both the content of inquiry and the operationalisation of the inquiry itself. Hence, the researcher and subject(s) are, in the fullest form, involved in all aspects of decision-making about the inquiry and in all experiences, i.e., as co-researchers and co-inquirers. In instances where the

researcher works outside of the subject organisation, the researcher experiences only part of the experience.[12] However, Heron and Reason (2001) do note that prior first-hand experience similar to that of those operating within the organisation may enable the external facilitator to be involved in a role of analogous inquirer.

[12] It should be noted here that feminist perspectives, especially those from within feminist participatory action research (e.g., Chrisp 2004) argues that each individual experiences the world differently because they each have many different characteristics that determine who they are and their behaviour. Hence, the notion of co-inquirers having 'the same experience' implied in this form could be considered a little unrealistic, and could instead be replaced with access to participation in all aspects.

Together, participants are involved in several linked cycles of activity agreement, engagement in agreed action, immersion in experience and reassembly to share experiences. Co-operative inquiry hence involves interplay between action and experience, and reflection and sense making (Heron and Reason 2001). A number of different types of roles are also recognisable within an inquiry group, including reciprocal (where each participant brings different strengths that lead to different tasks in parts of the inquiry), counter-partal (where participant brings different perspectives on the same situation) and mixed (including participants who share commonalities in practice, but not in context of practice) (*ibid*). Participants may also be involved in the same or different tasks for the duration of the inquiry, with varying degrees of input from those outside of the inquiry group, working with different types of knowledge at different stages, including experiential (i.e., from experience), presentational (expressed in non-written form, e.g., diagrams) and propositional (i.e., expressed as words and concepts), which are identified as sub-sets of practical knowledge (*ibid*). The use of joint inquiry approaches as a means of supporting the adoption and practice of adaptive management is justifiable given that the learning process is essentially commensurate with that of adaptive management. The focus on reflection at three different levels within the adaptive management process is therefore an essential part of any such inquiry.

The joint inquiry process is similar to that of action learning as described by Hagmann *et al.* (2002a, b). In this case, facilitation led by a clear vision, empathy and a culture of inquiry were considered essential. Roling and Jiggins (1998), Allen (2001), Hagmann and Chumba (1996), and Hagmann *et al.* (2002b), among others, argue that carefully constructed interventions can act as mechanisms that build capacity for learning in organisations. In particular, Hagmann and Chumba (2002) and Hagmann *et al.* (2002) have emphasised the significance of facilitating adaptive learning in singular cases in order to build wider organisational learning capacity.

Joint inquiry approaches (such as co-operative inquiry and action-learning) can be seen to incapsulate both constructivist and humanist notions of learning. The participation of research 'subjects' as equals in all aspects of learning addresses concerns about power differentials between 'teacher' (or knowledge holder) and 'student' (Blackburn 2000) influencing the desire to learn, and in ensuring novel practices are desirable and feasible. Constructivist notions are also evident in that the process involves engagement of a range of participants who each contribute skills and knowledge to the inquiry. Thus, joint inquiry addresses all of the assumptions identified by Argyris (1990) presented in section 2.4 of this chapter bar the

first (i.e., the ability to identify incongruencies in practice). This can be assumed in the decision to participate in the inquiry in the first place. Reflection can be prompted within joint inquiry processes by seeking explanations of information, and having co-researchers play the 'devil's advocate' (Heron 1996).

The use of joint inquiry as an approach to building reflection has been used in this thesis due to access issues that prevented me from developing participatory evaluation as an approach with the Mainland Island case studies. Staff involved perceived a mismatch between the costs (resources and staff time) and the benefits of the evaluation, and added that such an evaluation did little to resolve more pressing issues affecting project management. This led to the decision to focus on applying the adaptive learning model to part of their projects instead.

2.5.3 Individual reflection on social learning

The process of reflection within a group setting through the medium of dialogue forms part of a process of social learning. Social learning can be defined as "the collective action and reflection that occurs among different individuals and groups as they work to improve the management of human and environmental inter-relations" (Keen *et al.* 2005:4). Conversation between various groups involved hence provides opportunity for reconstructing experience (Pahl Wostl 2002). Reflection plays a central role in social learning process (Keen *et al.* 2005). An important part of the social learning process is individual reflection on the group process (Pahl-Wostl 2002, Brown *et al.* 2005). Through self-reflection, individuals are able to more fully consider material covered in the group context and move from apprehension to comprehension (Pahl-Wostl 2002).

As a consequence of this process, individuals' cognition of the situation in which they are involved can be demonstrated to change (for example, Steins and Edwards 1999b), which may lead them to forgo opposition to potential change on the assumption of convergent interest (Parkins and Mitchell 2005). Social learning processes can therefore be seen to provide opportunity for profound and fundamental changes in individual cognition of a particular situation (Siebenhuner 2004). Whilst there are clear issues of the power and legitimisation between local and scientific knowledges (for a summary, see Blaikie *et al.* 1997), similar issues also exist in the integration of different disciplinary knowledges within the sciences (Steiner 1993, Freudenberg and Alario 1999). An individual's interaction within group processes may be affected by whether they choose to represent their own perspectives or assert a perspective associated with a particular organisation, group, individual or

discipline (Ascher 2001). If they choose to represent self-serving interests, group learning may become perverse (Ascher 2001, Schusler *et al.* 2003). As such, the potential success of a social learning process is dependent on the ability of individuals to reflect on a situation and express that experience, and the potential for these experiences to be addressed within the group process.

The process of social learning between different stakeholder groups is central to the practice of adaptive management (Brown *et al.* 2005). Within the adaptive management literature, Schindler and Cheek (1999) argue that there has been a lack of attention to agency-citizen interaction as part of adaptive management. As Duncan (1998; 2000), Schindler *et al.* (1996) and Stankey and Schindler (1997) suggest, lack of attendance to social perspective can damage long-term relationships between communities and institutions, and erode support for adaptive management. In a report on social learning within adaptive management, Schindler and Cheek (1999) found an inclusive process increased the likely support for the project, skilled facilitation and early and continuous involvement enabled increased understanding of different perspectives, tangible outcomes enabled accountability and ownership, and evidence of incorporating ideas and experiences built trust, although participation was influenced by previous engagement with agency (Shindler and Cheek 1999).

Factors identified as contributing to the success or lack of success of social learning processes are summarised in Table 2.6. Many of these factors are also identified by other academics (e.g., Keen *et al.* 2005). Additional factors identified as contributing to success include the ability of participants to influence decisions (Stankey and Shindler 1997, Pahl-Wostl 2002), clear goals (Pahl-Wostl 2002), the implementation of agreed measures (Pahl-Wostl 2002) and conflict management (Lee 1993a, Pahl Wostl 2002).

Table 2.6: Success and limitation factors of group social learning processes – summarised from Roberts (2000) and Shindler and Cheek (1999)

	Factors perceived as contributing to success	**Factors perceived as limiting success**
Early developmental stage	Early and continuous involvement	Mis-match between expectations and delivery
Later developmental stage	Hands-on opportunity	Difficulty in keeping focus
	Comfortable environment	Fear of risk
	Understanding cultural issues	
	Good relationships	Expectation of passive learning
	Team work	Lack of knowledge
	Ability to influence decision making / Inclusive process	Lack of process planning
	Clear goals	Inexperience with participatory process
	Implementing project as agreed	
	Conflict management / Skilled facilitation	Less-positive prior encounters
	Tangible outcomes	

In combination, these factors provide a useful starting point from which to consider individuals' reflections of project success. Whilst this identifies key issues that are important in the adaptive management process, there is little to suggest how to illuminate and manage these throughout the process. Further, social learning theorists have argued that more research is needed in understanding the experience of participation in projects involving local knowledge (Blaikie *et al.* 1997), and in understanding the ways in which individuals' perspectives can influence perverse learning and how to overcome them (Ascher 2001).

Together, individual reflection on group learning process, and explicit reflection at each stage of the learning process (as occurs with joint inquiry) provide alternative approaches for building reflection on action. By applying each of these approaches, including formative for understanding the practice of adaptive management, I hope to develop substantive theory as is relevant to the New Zealand practice context.

2.6 Chapter conclusions

Whilst there are several common elements in the practice of adaptive management, there are also a number of contextual elements that affect its practice. I have argued that the process of emphasising disciplinary-derived emphases is counter-intuitive to developing the practice of adaptive management which must be based on contextual reflection rather than paradigmatic bias. In order to facilitate such reflection, the process of adaptive management has been re-constructed in light of apparently convergent descriptions of the reflective process from an array of other fields of practice. Whilst a focus of reflection on the context provides a potential means for overcoming issues related to the practice of adaptive management,

indications from other fields (particularly organisational learning) suggest it is difficult to achieve, and that initiating reflection by others requires the participation of those involved in the learning process.

In response to this, I introduced three reflection-building approaches used in this thesis to support the adoption and practice of adaptive management. In summary, the three approaches used to build reflection in this thesis represent reflection at two different scales and in two different forms: Formative evaluation, on the whole project scale, with individuals; Joint inquiry, on part of a project, with groups; and individual reflection on social learning, on part of a project, with individuals, but linked to the group process. The choice and use of these approaches was dependent on a mixture of my own interests and access to appropriate case studies. Thus, my initial interest in developing and using a participatory evaluation framework with a particular group evolved into developing one that I could work through with managers. The limited adoption of this idea also led me to focus on joint inquiry and individual reflection processes as alternative ways of supporting the adoption and practice of adaptive management.

Given that the aim of this thesis is practice oriented and that I have identified the need for a participatory approach to do so, I required a methodology that linked theoretical and practice based understanding. Action research, the methodology used to do so, is detailed in the proceeding chapter.

Chapter Three: Methodology and methods

3.1 Introduction

In choosing any research methodology, it is important to consider the purpose of the research and hence the requirements of the methodology employed to meet these ends. The purpose of this research is derived from the clear distinction between the theoretical support for adaptive management and the success in applying it, the intention being to improve understanding of its application.

The intention of this research is different to that of basic research. Bawden (1991) suggests that basic research poses a different question than that of research to improve practice. Basic research, based on reductionistic, hypothetical-deductive reasoning poses the question: given this phenomenon, why is it so? Alternatively, research to improve practice poses the question: given this complex problem situation, how can we improve it? These two questions differ substantially. The intention of the first is to generate understanding about some 'thing'. The second, in the use of the words 'improve' and 'we', signals a clear intent of change as part of some form of collaborative process. Thus, the second question indicates an intention of developing an understanding of how to foster some form of change, desired by some group of people, with regards to some problem situation that they find themselves in. My research purpose is akin to the latter question and hence a methodology that achieves this purpose has been used in this thesis. In this chapter, I argue for the use of a generic approach to action research in order to address this question. I then demonstrate its application, through the use of a range of methods, in this thesis.

3.2 An outline of Action Research

The coining of the term action research is commonly associated with Kurt Lewin who, in the 1940s described action research as "comparative research on the conditions and effects of various forms of social action and research leading to social action" (Lewin 1946 in Susman and Evered 1978:47). Later definitions have espoused the dual goals of both action *and* research that supports that action. Rapoport's definition (1970:499) goes further to emphasise the importance of collaboration as part of the research process, as is obvious in the following statement, "Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework". More recent attempts at defining action

research (e.g., Altrichter *et al.* 2002) are more a characterisation than an attempt to develop a narrowly defined and substantitively bounded definition.

Clearly, action research has at its core four key elements: (1) collaboration between a group of research participants including a researcher, who (2) participate in an iterative learning process about some situation, and (3) develop ways of exploring that situation, from which the understanding gained is used by participants to direct actions intended to improve their situation, enabling (upon reflection) (4) the development of theories of change from such situations. For the purposes of this research, I define action research as "research involving learning about interventions in practice acquired from interventions in practice". The process involved in action research is an iterative one involving multiple cycles of learning 'intervention'. Each learning cycle involves planning, action undertaking, observation and reflection (Lewin in Bawden and Zuber-Skerritt 2002). Each subsequent cycles of learning uses the reflections of previous cycles to guide them. Figure 3.1 represents this iterative cyclical learning process. The research component enables the development of theory from practice.

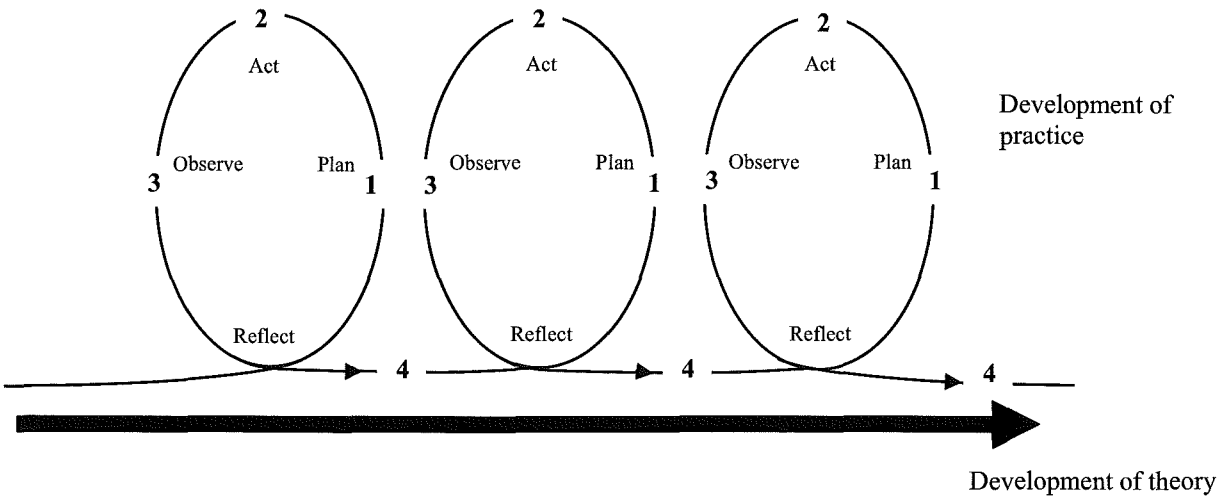

Figure 3.1: A depiction of the action research process. Each cycle of learning involves four steps (1) Plan, (2) Act, (3) Observe, (4) Reflect. Reflection enables a process of inductive theoretical development that is refined over time.

The research component of action research comes from explicitly recognising and reflecting on expectations of interventions. Checkland's (1985) depiction of this process (represented in Figure 3.2) denotes the framework of ideas (including assumptions about the situation) as F; the methodology for unpacking them and relating them to an area of interest as M, and the area or situation in which they are explored as A. For example, a researcher is working with a group of practitioners to build reflection on how their management could be more adaptive. In

this scenario, F represents ideas about the practice of adaptive management, M represents the methods used to explore them in a particular setting, and A represents the actual setting. The result of this process is that new understanding is gained in relation to the research setting, in relation to ways of working within it and in relation to the practice of adaptive management.

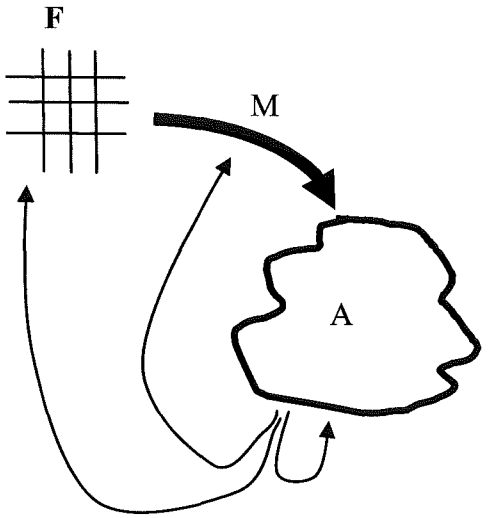

Figure 3.2: Checkland's depiction of the action research process. In this diagram, F represents a framework of ideas and M represents a way of exploring them in a given situation (A). On reflection, learning is gained about each (Checkland 1985).

When Checkland's learning process is combined with the cyclical methodology described in Figure 3.1, action research can be viewed as an inductive process involving cycles of learning about a framework of ideas, learning about ways of exploring them in a given situation and learning about that situation of practice itself. Thus, substantive theory development in action research emphasises each of these.

3.3 Action Research as a family of methodologies

Whilst it is true that applications of action research include a number of core elements, action research can be usefully seen as a "...family of research methodologies that pursue the dual outcomes of action and research..." (Dick 2002:159). A melting-pot of influences (including participatory research, critical theory, phenomenology and pragmatism) have contributed to the development of action research (Dash 1998). Combined with the gradual erosion of academic disciplinary boundaries, a range of approaches that share a desire to better understand problem structuring and change processes has emerged. Specific volumes of academic journals offering commentaries on such development (e.g., *Human Relations* 46(2) and The Learning Organisation 9(3/4)), and journal name changes (e.g., the Kluwer Academic Journal *Systems Practice* to *Systemic Practice and Action Research* in 1998) offer evidence of

these developments. Each form of action research methodology (including those from the systems sciences) deals with the four key elements[13] in a different way. Although there are many specific forms of action research the case for a more generic approach is also supported. Before it can be appreciated, an understanding of more specific methodologies is first necessary. Specific forms include, but are not limited to, Participatory Action Research, Action Science, Action Learning, Soft Systems Methodology and Critical Systems Methodology. Whilst this in no way represents an exhaustive list of different forms of practice, a discussion of them demonstrates similarities and difference that exist across a diversity of action research practice.

3.3.1 Forms of Action Research

Participatory Action Research (PAR) is common in developmental practice because of recognition that change is more likely to be successful when information presented to those involved is both practical and meaningful in their context (Dash 1999, Levin 1994). In such situations, the right to participate is also recognised as having moral and political value (Greenwood *et al.* 1993). Characteristic emphases of PAR include local knowledge, representation of a diversity of perspectives and the building of a 'common understanding' of a situation. Importantly, PAR incorporates the goal of emancipation or empowerment. In this sense, a researcher pursuing empowerment of participants is involved in a shift in the patterns of knowledge creation (Flood 1998). Hence, PAR involves research participants as co-researchers in a process that moves beyond reflecting on their assumptions about a particular problem situation to a critique of the structures that give rise to those assumptions, those which Carr and Kemmis (1986) refer to as a critique of bureaucratic systematisation. In such situations, it is argued that the role of the researcher is simply to support social action (Dash 1999, Carr and Kemmis 1986). Feminist PAR (e.g., Brydon-Miller *et al.* 2001) goes further to distinguish that disempowered participants themselves differ greatly, and hence a recognition of the multiple roles and perspectives of individuals participating ought to be considered in the design and enactment of the process. By extension, this also applies to claims of representativeness in reporting.

Criticisms of PAR have principally been about the development of appropriate rigour and relevance in action research so that non-rational action, which may lead to ill-considered decision-making, can be rigorously accounted for (Flood 1998). In differentiating between

[13] By this I refer to those outlined in section 3.2, i.e., collaboration, iterative learning, and approaches for exploring problem situations and theory development.

PAR and Action Science (an alternative form of action research), Argyris and Schon (1989) argue for clearer statements about whose reality is presented in PAR examples. They add that it is necessary to construct and test hypotheses or theories arising from action-reflection, to consider multiple causal explanations and to consider how change arising from action might not have occurred naturally (i.e., without the specified intervention). Hence, Action Science is primarily concerned with challenging assumptions that lead to specific courses of action in a defensible manner. Common to both PAR and Action Science is the process of Action Learning.

Action Learning can be described as a method primarily concerned with informed action, i.e., critical reflection on experience. Zuber-Skerritt (2002b) suggests that it is part of action research, but that it might only involve reflection on individual action, and does not necessarily include the reflection on assumptions underlying action or the development of theories of action. Action Learning has been described as an auto-therapeutic or catharsis-like process (Dash 1999). Action Learning can be thought of as a model of learning that addresses only Level One reflections (as identified in Chapter 2.4), i.e., reflection on action. In addition, Action Learning is often used by individuals to reflect on their own situation, rather than being used in situations where multiple and often conflicting perspectives on management exist.

Soft Systems Methodology (SSM) was developed to tackle what Checkland (1993) describes as 'real-world problems' in organisational development, i.e., those where multiple and conflicting perspectives do exist. One of Checkland's main contributions to action research has been to differentiate between hard systems, i.e., those situations with an easily defined objective or changeable perspectives on the objective, and soft systems, i.e., those situations that appear fuzzy because of a lack of a clearly defined problem or goal. In attempting to improve behaviour or deal with a problem situation, we must recognise multiple interacting values and depictions of a situation. The methodology of SSM built on the notion of collectively exploring different interpretations of situations and the systems that affect or interact with the situation. The methodology, developed from a 7-step process (Checkland 1981, 1988) into a two-strand process of cultural and situational analysis (Mingers 2000), emphasises problem structuring in an attempt to identify desirable and feasible change (Checkland 1985). Whilst SSM's impact is undeniable (see Holwell (2000) and Joldersma and Roelofs (2004) for examples of this), the methodology has also faced critique.

Flood and Romm's (1996a) Critical Systems Methodology (CSM) arose from a critique of SSM. It has been argued that SSM tends to support the status quo (Paton 2001, Mingers 2003), that there is a reluctance to move from problem structuring to action (Mingers 2000), and that the process of SSM is difficult to communicate to participants (Mingers 2000). The latter of these points has not gone unnoticed by supporters of SSM, and the methodology has itself evolved (see Mingers 2000 for detail). However, SSM has been challenged due to its focus on 'feasible' change, and therefore potentially lacking reconsideration of underlying world-views that may limit change in a given situation. For this reason, SSM may be considered coercive in that it fails to lead to emancipation of participants (Flood 1998, Mingers 2003). Alternatively, CSM raises awareness of coercive contexts by exploring tensions between different frameworks of ideas about systems, critiquing system depictions and the actions taken to improve them (Flood 1998). Hence, CSM attempts to change people's conceptions of the situation by challenging the rationality of possible actions that could be taken to improve a situation (Flood 1998). The difference between the two main systems methodologies is about how they deal with constraints to change – in CSM everything is 'up for grabs'; in SSM the approach is more structured and therefore more constrained. Thus, while systems methodologies can be considered a form of action research given that they involve intervention in practice, the emphasis is on problem structuring rather than action taking *per se*.

3.3.2 Integrative perspectives

Various academic discussions on the field of action research and comparisons of different forms of action research have occurred. For example, Chisholm and Elden (1993) suggest that action research varies in relation to the system level that change is targeted at, whether systems are loosely or tightly organised, the degree to which the process is pre-determined, the amount of change desired in research goals and the degree to which the researcher dominates the research group process. Dash (1999) concludes that forms of action research differ primarily in relation to the degree of learning used to direct action, whether it be autotherapeutic (e.g., Action Learning), reflective (e.g., Action Science) or liberating (e.g., CSM / PAR). There are also differences between methodologies in emphasising problem structuring, the development of approaches to support reflection, and criticality and theory building.

The need for research positions to be articulated as they relate to context has been expressed in different ways by academics. For example, CSM has been open to mixed methodologies

(Flood 1998). Gustavsen (1993:158) has recognised that the appropriate emphasis, i.e., on problem structuring, intervention process and susbstantive theory building, "It is to a growing extent something [the research position taken in attempting to link theory and practice] that has to be worked out in each specific context". This perspective is perhaps why too purist a definition of action research has been argued against (Holly 1991), and why Altrichter *et al.* (2002) provide a working definition of action research that encompasses all forms. Dick (2002) chooses not to define or bound action research, but argues that context will determine a series of choices, including: whether the project is theory or data driven; whether the researcher engages in the process propositionally or with limited resources, understanding and experience; whether the project emphasises research or action; which methodology or form of action research is used to explore the situation; the extent and style of participation and collaboration; the methods used for data collection and analysis; whether the project focuses on rigour or relevance (i.e., the degree of generalisability); and how the research is written up.

Dick's key point is that although there are many forms of action research, commonalities exist. These common characteristics include:

- An expressed empathy for participants and their experiences of a given management situation;
- A desire for understanding that is grounded in the realities of those experiencing a situation;
- A mixture of 'action' and research on it;
- Rigour in espousing ideas, assumptions about a situation and the purpose of interacting within it before 'action' is taken; and
- Reflection on and revision of espoused ideas, assumptions and purpose after action.

In order that the validity of action research be appropriately addressed, it is important that the methodology is first clearly distinguishable from positivist science.

3.4 Action Research and positivist science

Action Research can be differentiated from positivist science in a number of ways. Firstly, the nature of understanding sought is different. Criticism of research in the management sciences (for example see Susman and Evered (1978)) suggests the ends to be served by the knowledge created must be considered before determining the best method for generating knowledge to meet these ends. Similarly, Nodoushani (1999) and Ravetz (1993) have challenged the

seemingly hegemonic nature of positivist science and the neglect of certain types of questions. Proponents of Action Research commonly argue that the true nature of social systems is revealed when change is sought, and hence that we must act to improve understanding about action taking (Bawden 1991). Although not often made explicit, this suggests a pragmatic purpose for research (Reason 2003). However, the purpose is not purely pragmatic. The role of researchers in action research is therefore about facilitating change in an experiential way, and gaining understanding of that change. The focus on understanding how to improve a situation of practice is therefore considered more critical than understanding that situation in a more detailed way, although this information is certainly gleaned in the process.

Ontologically[14], Action Research differs from positivist science in that although it accepts the world to be true, it assumes that we do not have access to 'truth'- only to perceptions of it. It therefore follows that whilst individuals interact with the same external reality, their perspectives on it vary. This interpretation is akin to that of phenomenological epistemology[15]. The influence of phenomenological epistemology on Action Research is often cited (e.g., Checkland 1985, Flood 1998, Heron and Reason 2001, Holwell 2000, Mingers 2000, Zuber-Skerritt 2002a, Gustavsen 2003). Although tracing this influence is much more complex, some links can be made with relative ease. Given the noted ontological position, it is arguable that comprehensive knowledge is only achievable if the subject is considered to be identical in every aspect to the observer (Horstmann 1998). Hence, all knowledge, unless of oneself, can only ever be considered relative and in relation to an individual's experience (Churchman, 1971). This simple notion has clearly influenced ideas within Action Research. In an attempt to move towards comprehensive knowledge a dialectic is created between expectation and experience, the reconciliation of which increases comprehension. The cyclical exploration of problem phenomena thus involves a hermeneutic process of continued contrasting of experience and observation (Babbie 1998). This simple conception gives rise to the constructivist notion that individuals have different experiences of the same reality and therefore make different reason of it. This is evident in Action Research through consideration of the inability to be objective and therefore the need for participation.

In researching practice, the assumption that values can be separated from rationality (i.e., the premise of objectivity) is challenged. Evident reasons for this include that the requirement of divorcing values from actions is simply unrealistic (Levin, in Midgley 2003:82). Midgley

[14] Ontology is defined as "theory on the nature of being".
[15] Epistemology is defined as "theory about the creation of knowledge".

(*ibid*), citing evidence from the fields of physics and biology, claims that independent observations are themselves impossible, that all scientific acts are interventions and that even agreement between academics could be the product of social construction, adding that "if we are to divorce the exploration of values from science, then a key weapon in our arsenal for identifying and critiquing totalising ideologies has been marginalized" (*ibid*:92). Another challenge to the need for objectivity comes from challenging the nature of the systems themselves. Checkland and Holwell (1998) suggest that human and social systems are more volatile and that thinking and arguing can change social phenomena, given that they are themselves mental abstractions.

Action Research is not research for or on participants, but *with* them. The requisite of active participation is clearly articulated by Chrisp (2004:93) who states, "When participants are responsible for defining, modifying, directing and evaluating the research they are involved in, the outcomes can be powerful and far-reaching". Unlike positivist science, Action Research recognises participants as self-reflective people who, in situations where improvement is sought, can be initiators of change (Susman and Evered 1978). Thus, participation in practice leads to interdependence between object and subject. Participants in Action Research are involved in a process of defining and negotiating reality (Ledford and Mohrman 1993), gathering information, making decisions, and evaluating and reflecting on the outcome of those decisions (Altrichter *et al.* 2002). Participation in Action Research is, however, variable in extent. Levels of participation may differ in relation to the research topic, the methods used to explore it, decisions about how the situation is bounded, decisions about what action is needed to improve the situation and who should be involved in doing so.

The explicit recognition of the role of the researcher as an active participant in the research distinguishes Action Research from both positivist science and other qualitative methods. The interventionist role (facilitating and supporting capacity building and providing opportunity for reflection) brings a large ethical responsibility on behalf of the researcher. Clearly, there is a need for the researcher to be explicit in the values they bring to a situation and their ideas about it (Kemmis and McTaggart 1988, Greenwood *et al.* 1993, Ledford and Mohrman 1993). These may affect participation in the process, facilitation, how group processes are managed (especially differentials in power relations), the theory building issues and even the 'buy-in' process. In Action Research, the role of the 'researcher' must be recognised as a privileged one, where trust is indebted in helping facilitate a process and often, in documenting it. Further, the researcher may be involved, in everyday life, within the situation of interest.

Chrisp (2004) suggests that the researcher will have (as will any participant) a multiplicity of experiences and allegiances that enables them to identify with co-researchers in a number of ways that are more complex than this dualist insider/outsider classification. The following excerpt from Chrisp (2004:92) describes these experiences:

> The social change oriented researcher operating from within the academy is caught between opposing forces and motivations. For some this brings the research to standstill; the researcher can never "get it right". My challenge is to continue knowing that I am not going to get it completely right…my hope is that maybe I will get it more right than last time.

Action researchers may experience trust or solidarity, and they may be privy to more or less information and a more or less open dialogue process because of this. They are both vulnerable (Bell 1998) and at the mercy of the politics of inter-personal and organisational relationships at the same time. Further, this consideration suggests that whilst the process of inquiry in Action Research is collaborative, a researcher reflecting on the experience provides a limited construction of the situation. As such, they must be an exemplar of the Action Research process in acknowledging how their own perspectives on a situation influence their interpretations (Oja and Smulyan 1989). Key differences between positivist science and action research with regards to the aspects outlined in this section are included in Table 3.1.

Table 3.1: Key differences between Positivist Science and action research

Positivist Science	Aspect	Action Research
Understanding phenomena	Purpose	Understanding the changing relations between phenomena over time
Access to same 'truth'	Ontology	Access to 'truth' is mediated by previous experiences, therefore truth is observer dependent
Comprehensive experience	Epistemology	Only comprehensive knowledge possible is of oneself
Object-subject separation		Interdependence between object and subject
Research conducted for self serving ends, by oneself	Participation	Knowledge jointly developed to increase comprehension of reality and ensure relevance

3.5 Validity in Action Research

Issues pertaining to appropriate validity in Action Research and its attainment have remained largely unattended in the literature (Dick 2000). As previously argued, the nature of researched phenomena differ from those of positivist science (Altrichter 1991). Due to the complex nature of 'soft' systems, it is not assumed that they remain invariant and independent through time (Susmand and Evered 1978), nor that we have access to reality beyond

perceptions of it (Swepson 1995), nor that phenomena will incur similar meaning outside of their context (Susmand and Evered 1978) and hence that methodological standardisation is appropriate (Dick 1997). Whilst evidence of change may be collected in relation to a number of variables (Kemmis and McTaggart (1988)[16], an assessment of validity based change alone ignores some of the complexity associated with achieving change. As noted by Weiss (1995), Pahl-Wostl (2002) and Keen *et al.* (2005) a lack of evidence of change does not necessarily mean that understanding about the potential for change has not been developed nor that change has not occurred – it may just be different to what was expected and therefore difficult to detect. Alternative criteria for validity thus deserve exploration

Britt (1997) suggests that four types of validity should be considered. Firstly, descriptive validity focuses on consideration of alternative depictions of events, evidence for conceptual respecification (i.e., change in perspective over time) and contextual influence on this. Secondly, interpretive validity focuses on the coherence of links and inferences made. These two forms are equivalent to internal validity of positivist science. Thirdly, explanatory validity focuses on the links between theory development and data that contribute to causal explanations. Lastly, predictive validity emphasises the applicability of data to other situations rather than the understanding of it. These two forms of validity are equivalent to external validity of Positivist Science. In Action Research, there are measures that can be taken to strengthen each of these types of validity. Descriptive, interpretive and explanatory validity are increased in Action Research by participation, triangulation, cross-case analysis, continuous and systematic reflection and theory building through successive cycles of learning.

Participation in the research ensures that depictions of a situation are relevant and meaningful, and thus representative of actions, supporting descriptive and interpretive validity. For example, feedback on or involvement in crosschecking of records, planning, reflection on action and reporting ensures that the researcher's account of events is accurate and that the interpretation is realistic (Dick 2000). A weakness here is that the relative benefit of an intervention in comparison to an alternative process is almost impossible to ascertain given the difficulty in identifying appropriate 'controls'. Participation within action research therefore provides a process that is both grounded in the realities of the individuals involved and therefore relevant to them.

[16] Examples of these include language and discourse, activity and practice, and social/organisational relations.

The technique of triangulation can be used in multiple ways to increase validity in Action Research. Triangulation is generally described as the use of multiple sources and types of data and analysis in order to overcome bias or weakness associated with the use of individual sources, methods, and theories (Patton 1987, Denzin 1989, Roe 1998). The collection of multiple sources and types of data and analysis can provide opportunity to seek exceptions to uniformity in data. Thus, the interpretive validity of observed phenomena are increased (Argyris and Schon 1989, Dick 2000). A further type of triangulation is the use of multiple cases. Cross-case analysis has been developed in a number of fields. Its use within evaluation has traditionally focused on cross-case analysis or meta-evaluation of others' evaluations, primarily of quantitative data (e.g., Robertson and Seneviratne 1995, Rosenthal and Deimatteo 2001). Within Action Research, cross-case analysis is suggested as an option to improve rigour and generalisability of findings (Huberman 1987, Chisholm and Elden 1993, Elden and Chisholm 1993, Dick 1997, and Conradi 2002)[17]. Cook and Gruder (1978) suggest that meta-evaluation has the ability to increase validity and credibility in data analysis. They suggest that sequentially developed evaluations provide even greater opportunity for it, although often at the expense of depth in individual cases. Yin (1984) credits cross-case analysis with increasing validity in explanation building. There are however some technical issues. Conley and Moote (2003) note the importance of comparable data for legitimate meta-analysis. In addition, Conradi (2002) suggests that individual cases used in the analysis will differ in relation to the rigour with which they are analysed and reflected on. Thus, similarities in case contexts and in the methods used to explore them are important considerations.

Through the Action Research learning process, propositions about a situation can be explored (Dick 2000). Successive cycles of linked action and reflection enable developed interpretations and theory to be tested (Dick 1997), increasing explanatory validity. In this sense, the theory or tools may be developed across successive cycles of learning, and hence different cases may be used (Zuber-Skerritt and Perry 2002). Gloster (2000) developed a systemic depiction of this process of theory development and testing, which he describes as retroduction (Fig. 3.3) whereby assumptions about the nature of the system are both formed and tested simultaneously. Retroduction requires continual assessment of both the system in which the action taking is occurring (e.g., a local branch of an organisation), its external environment (e.g., the organisation as a whole) and their interaction. Interpretation and theory

[17] It is worth noting that calls are also evident for cross-case analysis in adaptive management (Salafsky and Margoulis 1999, Salafsky *et al.* 2001, Garraway and Arthur 2002a, 2002b, Brown and Salafsky 2004).

developed within a retroductive framework increase the explanatory validity by coupling both inductive and deductive learning processes.

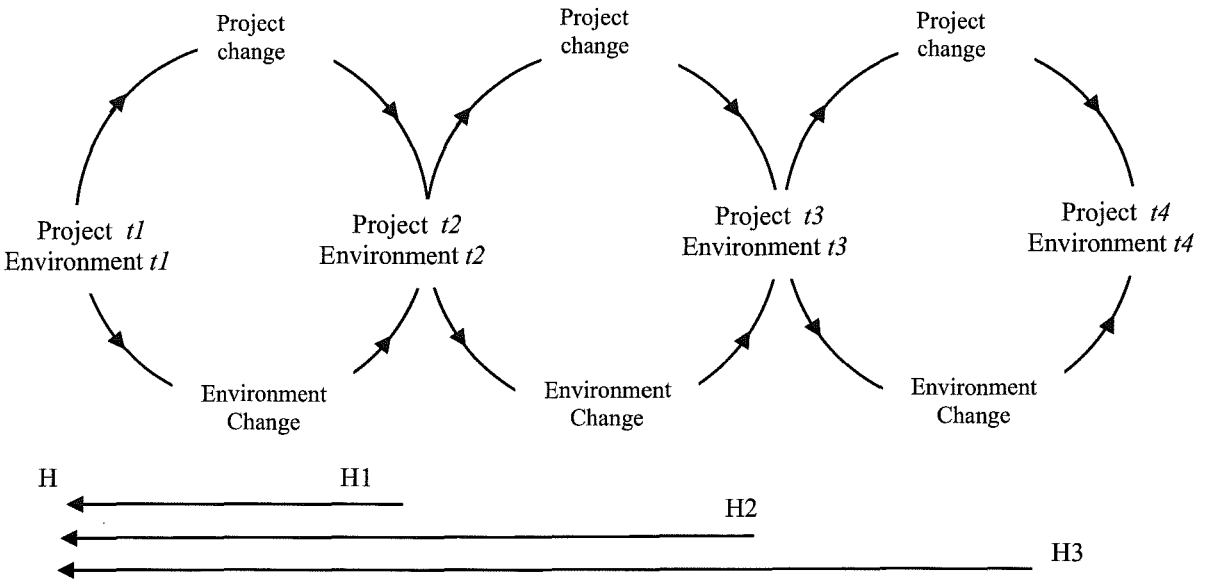

Figure 3.3: Retroductive theory development (adapted from Gloster 2000). This diagram shows the development of theory (H) about a project situation over time.

The focus of action research on situations of practice means that less attention is given to understanding the degree to which lessons are transferable to other situations. The generalisability of action research is considered weak. The position of action research within the hermeneutics paradigm suggests that all knowledge is built on presuppositions and hence those individuals contributing to the research will affect which datum are observed and considered relevant. Predictive validity is also problematic in action research given that it is difficult to identify all variables affecting the situation (Dick 1997). In action research, precision and replicability are forgone in a trade-off for relevance, enabling processes to be tailored to the situation at hand. Checkland and Holwell (1998) argue that whilst replicability is an impossibility, all steps in the process and the links between them must be described so that the process is recoverable[18]. Further, some academics argue for the comparative study of multiple cases (i.e., cross-case analysis and meta-evaluation) to increase the predictive

[18] In order to achieve recoverability, Checkland and Holwell (1998:20) note that "it is essential to state the epistemology (the set of ideas and the process in which they are used methodologically) by means of which they will make sense of their research, and so define what counts for them as acquired knowledge". Whilst the use of the term epistemology may differ from other descriptions, the process of recoverability is further described as a "declared-in-advance methodology" (*ibid*:18) whereby the framework of ideas, methods for exploring them in a given situation and prior perspectives on that situation are clearly stated at the outset of the research.

capacity of research findings. Both the need for recoverability and the ontological and epistemological positions of action research outlined earlier contribute to its ethnographic focus. Key differences between notions of validity in Positivist Science and action research are compared in Table 3.2.

Table 3.2: Differences in notions of validity between Positivist Science and action research in relation

Positivist Science	Aspect	Action Research
Use of control	Descriptive	Participation, triangulation, reflection
Small within group variance	Interpretive	Participation, triangulation, reflection
Randomisation of treatments Minimise psuedoreplication	Explanatory	Weakness, but strengthened through Triangulation, reflection
Intra-group variance smaller than inter-group variance	Generalisability	Weakness, but strengthened through triangulation, reflection
Deductive or inductive	Theory development	Retroductive – coupled deduction and induction

The participatory nature of action research may lead to challenges about the independence of an action researcher's contributions to the research. To these ends, Zuber-Skerritt and Perry (2002) and Perry and Zuber-Skerritt (1992) distinguish between the actual theoretical developments by the individual, i.e., the 'core project' and the case-based project conducted with the group. Activities in the core project include planning the research problem and rationale, observation and reflection on the core project, analysis of it in relation to literature, theory building and suggestions for further research.

3.6 Action Researching adaptive management

In researching adaptive management, I make the assumptions that: (1) it is an important approach to the management of complex systems, (2) that current understanding of the approach is inadequate to support practice; and (3) that by working with case studies in an interventionist way, the practice of adaptive management and theoretical perspectives on it can be developed. An important distinction to make at this stage of the chapter is the difference between action research and adaptive management. Core to both is a cyclical process of learning and, as I have argued in both Chapter Two and earlier in this chapter, a process of critical reflection on action. The use of action research to understand adaptive management provides an explicit attempt to build substantive theory on the practice of

adaptive management. A limited ability (i.e., because of time restrictions) to test this theory in other contexts limits claims to generalisability beyond the conservation management context it was derived in. While I argue for reflection on the practice of adaptive management, this does not necessarily result in such explicit attempts to build theory on practice, principally because adaptive management does not involve the explicit and deliberate attempt to understand the implications of processes used to support practice.

The need for real-life situations in which to study practice necessitates the use of case-studies in any action research project. My choice of case study context was based on the fact that the term adaptive management was becoming prevalent within conservation management in New Zealand although only limited interpretations existed. I limited my selection of case studies to those either explicitly practicing or considering adaptive management so that theory built from the analysis was not perceived as ill-contrived. Further, I chose cases with links to the Department of Conservation (DOC) in order that management purpose and organisational mandate (two characteristics identified as influencing the practice of adaptive management in Chapter Two) were common across cases. This enabled a degree of continuity and the potential for increased explanatory validity when comparing cases. As noted in Chapter Two with respect to my choice of approaches for building reflection on adaptive management, the perceived usefulness of my research interests and constraints of involvement faced by participants also influenced which cases I had access to.

As per Dick's description of a more generic approach to the use of action research (Dick 2002), a number of choices were made that influenced the specific methods used in this research. My first choice was to be data-driven by using existing theory to explore the practice of adaptive management. The primary reason for this was due to my concern about the paradigmatic interpretation of adaptive management and the dichotomy of perspectives on practice that this created (see Chapter Two for detail). The early stages of the thesis emphasised research over action because of my desire to engage from a theoretical position. The latter stages of the research emphasised action in order to develop theory from practice. This mix of emphases was also due to the need to build relations with the projects in which I wanted to work. The extent and style of participation used was hence developed throughout the project to include higher levels of participation. Each learning cycle was jointly negotiated with key management staff in order to establish a mandate to work with them and to ensure relevance.

Central to action research is the need to ensure relevance of any intervention attempt. The ability to do so is supported by 'grounding' in the research phenomena, referred to by Tolich and Davidson (1999) as 'field work'. Loftland and Loftland (1995) suggest that field work can be useful for identifying meaning, examining behaviour, roles, organisations, settlements and relations within a group. Thus, whilst not a standardised method per se, fieldwork provides opportunities for developing understanding of cases within which action research methods can then be applied.

In this thesis, I became immersed in the case context through a number of informal activities, including numerous visits to the various conservation projects with research participants, home visits with participants, phone and email conversations, cups of coffee and attendance at meetings and Hui. These things enabled me to gain an understanding of case study context, enabled a richer understanding of peoples' perspectives on it and gave me credibility as a researcher. An example of this is an overnight field visit with staff involved in one case-study, who were able to demonstrate their local knowledge by uncovering an individual plant browsed by deer from the cover of ground ferns, explaining that when deer numbers were lower, this tree would grow above fern cover. As noted by Tolich and Davidson (1999:20) fieldwork "gives you a remarkable ability to get under the skin of those from whom you are learning".

Observations such as that presented above have provided evidence to support the development of a particular theme or line of argument (in the example provided, the argument is about the influence of local knowledge on management). Fieldwork observations have also provided opportunity for critical reflection on research directions, approaches and methods, and have hence influenced the values brought to the research and choices made in it. As noted by Loftland and Loftland (1995) and Tolich and Davidson (1998), articulation and reflection on the significance of values and their influence is important in ensuring reliability of data. The confessions of a researcher presented in Chapter One of this thesis, and my own research practice journal[19] ensured a true record of critical reflection of emerging values, interests and concerns alongside their influence on the research.

[19] The use of a practice journal is argued for by Tolich and Davidson (1998) as a means of promoting self-reflection on the part of researchers. In my own journal, I noted plans for action, why I felt they were appropriate, what occurred as a result, what I felt was expected and what was unexpected, what may have led to these feeling, the implications of this for my own theory building and the logical 'next steps' in developing that theory.

It is also important to note here the implications of the differing nature of my relationship with the participants. Many participants I had never met, some I have working relationships with as a co-researcher, and some I had supervisory relationships with. I managed the differing relationships in a number of ways. Firstly, I was explicit in that I was seeking their participation in their professional capacity. Secondly, I expressed openness to them feeling uncomfortable because of a perceived conflict of interest, and told them that they should not participate because they felt they had to or should do, nor should they feel compelled to adjust their response because of a perceived reaction to it. Thirdly, as with all participants, I offered a guarantee of confidentiality and complete withdrawal of data at any stage, sought permission to record the exercise, and offered access to all documentation including appropriate transcriptions.

One particular case requires special note. My ability to conduct thesis research in the adaptive management to restore forests affected by deer (FAD) project was influenced by my involvement as a research objective co-leader in an externally funded project, which came to fruition partly from the working relationships I developed during thesis research. In this instance, my ability to gain research buy-in from those involved was influenced by the relationship I had built with potential participants through the FAD working process. Careful attention was given to the ethical responsibilities of my role as both co-facilitator in FAD and as an external researcher by the project manager who introduced my study to potential participants and stated clearly that their non-participation would not affect the working process of the project in any way (note that Human Ethics Committee approval was sought for this cycle of research). Reflections on ethical concerns are included in Chapter Eight.

Given that there are many attributes of a researcher (in addition to *a-priori* relationships) and attributes of a research situation that may influence participant responses in personalised settings, I was attentive to making note of perceived non-provision of information or neglected detail, and to checking my interpretations of participant comments. Importantly, different levels of openness on the part of participants does not jeopardise the key purpose of this section of research. Whilst Human Ethics Committee approval is not a requirement at Lincoln University in cases where participants' research involvement is within their professional capacity (as was the case with all but one of my research cycles), ethical procedures, including the provision of research information and consent form, have been followed. Appendix 2 provides examples of information forms for each instance in which they were necessary. A further point of note here is that guarantee of confidentiality and

anonymity has strong implications for giving voice to participants' perspectives in the research presented; the size (both physical and population) of New Zealand is such that practitioners are regularly in contact with one another, increasing the requirements for preserving anonymity.

Within individual chapters, a range of methods were used in data collection under the guises of the tools previously outlined. In this thesis I have chosen to provide minimal detail of methods used within individual chapters in order to avoid unnecessary repetition. Instead, I have presented a summary of the methods used and the way they were used within this chapter.

Five research cycles form the core data gathered in this thesis. The first three involve formative evaluation; the fourth involves co-operative inquiry, and the fifth, a study of social learning processes. Table 3.3 provides a summary of the methods used in conducting research during each cycle. Discussion on the use of specific methods follows. Importantly, each research cycle was jointly negotiated between myself and participants, with mentoring support from within DOC and from University supervisors.

Table 3.3: Summary of the methods used in conducting each of the research cycles.

Method	Cycle one	Cycle two	Cycle three	Cycle four	Cycle five
Purpose	Understanding participants' perspectives and the need for formative evaluation in the given context	Understanding variety in existing perspectives on AM and getting buy-in to further research	Working together to reflect on practice	Working together to implement an adaptive inquiry process	Understanding participants' experiences and how the parent project process could be improved
Approach	Formative evaluation	Formative evaluation	Formative evaluation	Joint inquiry	Reflection on social learning processes
Primary data source	Individuals' reflections on the practice of adaptive management in New Zealand	Individuals' reflections on current project management and similarity with adaptive management	Individuals' reflections on use of adaptive management at whole project scale	Group's reflections on particular part of project conducted in a similar vein to adaptive management	Individuals' reflections on activities as part of parent project implementing adaptive management
No. individuals involved	13	17	6	5	20
No. sources cases / case groups	9	7	5	1	4
Additional unsuccessful attempts at engagement	1 additional individual unavailable due to time commitments	2 additional individuals unavailable due to time commitments	1 individual gave only partial response due to lack of perceived utility of the exercise	2 groups did not complete data collection and interpretation. See Chapter 8 for discussion of this	5 individuals unavailable, including 3 due to time commitments, and 2 for unknown reasons
Exercise type	Semi-structured interviews	Semi-structured interviews	Project evaluation	Group inquiry using an adaptive learning process	Semi-structured interviews
Questions (if appropriate)	Their experience of AM and/or Matauranga Maori	Their perspective on AM; ways in which affiliated project is / is not adaptive. Probing questions based on AM steps	Additional questions on the perceived usefulness of the exercise, potential usefulness to others and potential improvements	See Appendix Four for schedule of questions designed to build reflection on inquiry objectives and results	What went well/less well and why; unexpected issues; new concerns; resolution of previously noted concerns
How activities conducted and records kept	In person – notes taken and recorded if permission given	Either in person or by telephone (at individuals' discretion) – notes taken	In person – recorded and notes taken	In person, by telephone and by email – reflection session recorded, otherwise notes taken	Primarily by telephone – notes taken unless in person (2 individuals)

3.6.1 Methods used in conducting research

Interviews

Within action research, interviews can form a major component of data collection (Munford and Sanders 2003). According to Yin (2003), interviews provide a targeted and insightful means of data collection. The structure of interviews varies dependent on the use of material sought from them (Denzin 1999). The style of interview used in this thesis depended on the purpose of data collection. In cycle one, the use of semi-structured interviews was important given that I was interested in using insight from how participants structured their responses in developing the participatory evaluation framework. In cycle two, I desired more detailed information relevant to cases, and therefore used a greater number of probing questions.

Participant questioning was standardised within research cycles in all cases but cycle one in which iwi participants with limited or no explicit knowledge of adaptive management were asked to describe Matauranga Māori (i.e., indigenous knowledge systems) and Kaitiakitanga (i.e., the enactment of guardianship) given that these two concepts encapsulated traditional indigenous management in this culture. The nature of questions used in each chapter relate specifically to the information sought. Given that the intent was to build capacity for deeper reflection, probes were also used, including asking for clarification and justification of perspectives, and thus enabling a greater level of depth (Gillham 2000).

For all interviews, contact was made via email, followed by a telephone call, in which I explained the purpose of the interview, the process and questions used, how data would be analysed, and the time required. All interviews were conducted in a one-to-one situation to ensure confidentiality, except where specifically requested by participants. Participants were also given the choice of telephone or in-person interviews in order to be considerate to personal preference and time available. Whilst Gillham (2000) notes that telephone based interviews do enable participation of geographically dispersed participants and larger number, limitations include the inability to gain additional insight from non-verbal communication signals. Whilst this might be considered a weakness, time spent establishing relationships with many participants prior to interviewing meant that neither myself nor the research were unfamiliar to them.

The responses given by participants are considered to represent issues pertinent in individuals' perceptions of the adaptive management process. It could, however, be argued

that failure to discuss some aspects represents either a lack of salience on the part of the participant or poor question formulation. Participants did give a volume of information unrelated to questions or probes, in addition to noting that they felt very comfortable with being interviewed, and enjoyed the opportunity to express their opinions and gain voice for their thoughts. Hence, it is considered that failure to discuss some aspects of either adaptive management or the adaptive management process suggests that participants either do not see them as important to adaptive management or to project management.

Framework development & reflection exercises

The formative evaluation framework developed in chapter two was initially modified by the progression of discussion about participants' experiences (cycle one). In the second research cycle, whether or not criteria were incorporated into the framework as questions was dependent on:

- Duplication of ideas;
- Whether ideas were central or peripheral;
- Integrity in the process (i.e., links from defining of goals to their evaluation in latter questions);
- Addressing my concern about the need to consider both ecological and collaborative aspects of adaptive management (as noted in Chapters Two, Four and Five); and
- Relevance to the New Zealand context.

In cycle three, opportunity was provided at the end of each step to adjust questions therein. Opportunity was also provided at the end of the exercise to provide feedback on it. In cycle four, a 'reflection' session was conducted after data had been analysed. This session reflected on each inquiry objective, and then on the exercise as a whole. In cycle five, I asked participants to reflect on changes in their experience, interests and concerns about the parent project activities. These questions are typical of those asked in evaluating activities, and were deemed relevant by the parent project facilitators. Further, for those project groups active during the period of study, and for individuals who consistently attended group activities, I was able to repeat interviews and monitor the alleviation of concerns (n=9). Noted interests and concerns in workshop notes provided an additional starting point for supporting individuals' reflections on these changes.

Participant selection

Participant selection was conducted in cycles one to three by means of a stakeholder analysis. In cycle one, I strategically involved those individuals who might have interest or influence in the way Mainland Island participants interpreted adaptive management given that it was my intention to attempt to work with them in cycle two. The involvement of groups (i.e., above and beyond the criteria for case selection already presented) was on the basis of the similarities drawn between adaptive management and traditional ecological knowledge by Berkes *et al.* (2000), and my interest in creating the potential to explore this further if appropriate cases were identified (n=5). Cycle two included staff in a range of different positions associated with the Mainland Islands (see Chapter Six for detail). In cycle three, the same criteria were applied as in cycle one bar the involvement of groups due to lack of my ability to work with these groups. However, there were only two instances of overlap between the first and third cycles. One member of the initial group was omitted because of lack of continued involvement in an explicit adaptive management process, two had left New Zealand, and two others were omitted because of concerns of over-burdened involvement. A previously unavailable person was luckily available, and two others associated with newly established projects were involved.

3.6.2 Methods used in analysing research

I used a range of different analysis procedures in each research cycle. Table 3.4 provides a summary of these and the demonstrable outcomes associated with each cycle. In cycle one, interviews were analysed using concept mapping. This technique, often referred to as cognitive mapping (e.g., Eden 1988) or spidergrams (e.g., Lynman *et al.* 2002) maps the inter-relationships between ideas within descriptions. These maps were then used to compare interview participants' perceptions on adaptive management, enabling a form of triangulation referred to by Dick (1998) as convergent interviewing whereby similarities and differences between interviews provide opportunities to develop probing questions to be developed. As Dick notes (*ibid*), these probes seek to find exemption to areas of convergence, and reasoning for divergences between perspectives.

Table 3.4: Summary of the methods used in analysis of each research cycle.

Method	Cycle one	Cycle two	Cycle three	Cycle four	Cycle five
How analysed	Concept mapping	Responses considered against evaluation criteria	Evaluation checklist graded during exercise and reflections transcribed and analysed thematically	Level and timing of reflection analysed from transcription	Thematic analysis of experiences conducted on notes, experience considered as a whole rather than in response to each question
Triangulation/ comparison	Convergent analysis	Staff responses pooled by project groupings and responses compared to project review information	Responses compared in relation to each framework question	Successful attempt compared to less successful attempts	Themes raised by different participant types compared
Demonstrable outcomes	Collaborative, experimental and managerial perspectives distinct in the eyes of practitioners	Reflection on the interpretation and use of adaptive management	Multiple case analysis of previously un-noted lessons about the social context of adaptive management practice in New Zealand Reconsideration of project planning and reporting in light of reflection exercise	Joint inquiry exercises provide a useful way of introducing adaptive models of learning Joint inquiry experience was noted as a new and more enjoyable way of working	Extended list of factors contributing to and limiting the success of social learning processes as part of adaptive management Improvement in the design of parent project process in light of feedback
Interpretation checks	Notes and transcriptions offered to participants for comment	Notes offered to participants for comment Report circulated to participants for comment	Chapter offered for comment	Interpretation of results done by group Chapter offered for comment	Notes offered to participants for comment Chapters offered to project manager for comment
Additional notes					Summary of data provided to parent project facilitation team for incorporation in activity planning Repeat interviews conducted to check for resolution of concerns (9 instances, 2 groups)

In cycle two, participants' notes from their respective groupings (see Chapter Six for detail) were pooled and considered in relation to the developing evaluation framework. By pooling responses to different questions, I made the assumption that opportunity for adaptive management was dependent on knowledge of it, the ability to identify differences between this and current management and to address areas where management might be problematic. Further, I pooled data on the assumption that a fairer assessment of the potential for adaptive management was dependent on the sum of the various specialisations that contribute to management at a particular site. Group analyses, and other comments were also contrasted against case-based literature, primarily from case-based reviews (e.g., Saunders 1999, 2000a, 2000b, Saunders and Norton 2001) and individual site-based management reports. This enabled me to gain a better understanding of whether or not analysis and reporting in that project met the criteria for reporting. Where differences did exist, I was able to ask more detailed questions. For example, I might suggest to an interviewee: "You say that reporting is done regularly, but another interviewee noted that it is haphazard. Can you think of a reason for this difference in opinion?" As a consequence, I was able to gain greater depth in analysis, or at least to probe for counter explanations.

Whilst it is normal process in case study research to record and transcribe interviews (Tolich and Davidson 1999, Babbie 2004, Gillham 2000), many of the interviews were not transcribed. Instead, a combination of quotations and notes was used. For two interviews, I both recorded notes, and transcribed, and found no difference in terms of the insight able to be gained from data. Whilst in retrospect, transcriptions would have provided a means of more detailed analysis, a more accurate 'test' of data in action research is in their ability to be useful. This has been ensured by interpretation checks, including paraphrasing and asking 'is this what you mean?' during interviews, by returning notes and asking participants to make changes, and by involving participants in interpretation of findings either directly (see Appendix Five for an example of this), or through review of written accounts of exercises.

Interview transcriptions and notes from cycles three to five were coded using thematic analysis (see Fig. 3.4 for an example of this using a transcription). Coding was done following the description of open coding by Babbie (2004), whereby codes represent the question and insights gained by the researcher, i.e., the substantive theory. In the data chapters (especially Chapter Eight), quotes and quotes of my notes are used to illustrate key points made by participants. Where diversity was evident, this is also presented or commented on.

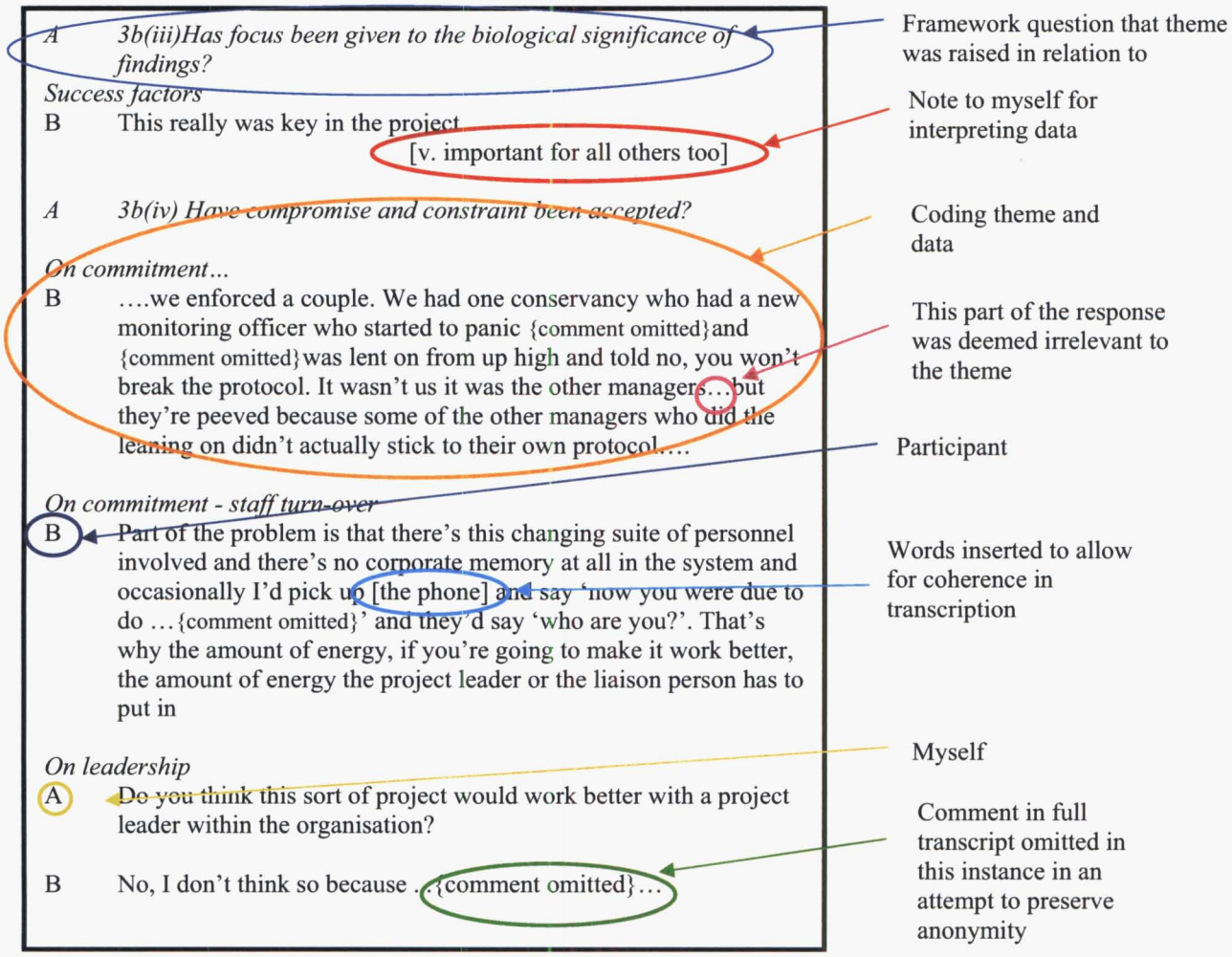

Figure 3.4: Sample coding for thematic data analysis

In cycle five, agreed feedback from participant interviews following group-based activities were pooled and used in the design of further activities with the same and other groups. Repeat interviews and the staggered development of learning groups enabled me to check for alleviation of previously identified concerns in the reflections of others' from different groups.

Throughout the research, the development of substantive theory was tested in successive research cycles. This enabled me to draw conclusions about support for the practice of adaptive management within the New Zealand conservation context. Whilst I began this research with the assumption that adaptive management was limited in practice due to practitioners ignoring social aspects, and that the same mistake was about to be made in the New Zealand context, this has been refined to be framed as a concern about lack of consideration of practice context per se and the role of institutions in constraining potential practice. Successive research cycles contributed to refining of my own understanding by testing expectations of my evolving preconceptions about how a participants involved in case

studies might respond to my actions. What was necessary was for participants to contribute to interpreting why a particular activity was or was not relevant, which I did at the end of each exercise.

3.7 Chapter conclusions

The use of action research methodology has provided a structured approach to developing both the practice and theory of adaptive management. This chapter provided an over-view of the methodology. Furthermore, the use of a generic approach to action research has enabled a combination of different approaches and methods relevant to both my own interests and to those of the individuals involved. My own learning process associated with the practice of action research went through substantial development during the course of the research.

The first major hurdle I encountered was in moving from theory to practice. My desire to be engaged in data gathering from a propositional perspective was due to my initial research position that discourses on adaptive management needed reconciliation, and that without consideration of the social context of management, adaptive management was at risk of being practiced 'incorrectly'. My assertion about the need for increased awareness and reflection on the social context of management at the local level remains, I believe, a valid one. However, it most likely influenced my relationship building with Mainland Island cases and an inability, at first, to see that this perspective was not the most pertinent factor limiting their ability to be adaptive. Less attention to theoretical development at the initiation of this thesis may have avoided the sense of frustration derived from slow progress with case studies in the early stages of this thesis research.

Gaining entry to case studies used in this thesis was the second major hurdle I faced. Whilst many action research theses are conducted from within the workplace situation, I believe these situations are considered to be more suitable only in that they limit the amount of time needed to identify potential research directions. However, buy-in to participatory practices is still essential and may be problematic in any situation (Heron and Reason 2001). I did face an inability to gain buy-in to what I considered to be desirable research directions, i.e., testing a refined formative evaluation framework with a group of case study participant reflections used to help refine it. If the research had been hypothesis driven, then this would be of less concern and the research could have progressed based on detailed analysis of how they responded. However, the participatory ethos of action research meant that I was interested in why they seemed uninterested in doing so, and how this observation might be perceived in

light of generating substantive theory about the adoption and practice of adaptive management in this context.

The third significant hurdle faced during this research has come in attempting to complete an action research thesis and meet criteria for innovation and excellence that are set by institutions traditionally positivist in their outlook. Throughout the duration of this research, I have asserted that action research within the university context is not well understood, resulting in the presentation of a conference paper on the challenges to action research within the university setting (Morrison, Reid, and Jacobson 2004). In particular, I believe this is derived from the notion that the process of achieving case-based insight is inextricably linked to the process used to gain them, which consequently also becomes a focus for research, and, as I am coming to realise in writing this thesis, a difficult one to communicate due to the need to balance both case detail (i.e., the 'practice' element) and to show recoverability in the research process (see p. 62, this chapter). Central to positivist concerns regarding action research remains the inability to compare different approaches to intervention in order to ascertain predictive validity. The trade-off made in action research is thus similar to that made in adaptive management, between the attempts to appeal to positivist notions of value, and to assure relevance to those participating. The contribution of this thesis has hence primarily been an attempt to bridge the divide between research and practice, and an attempt to inductively develop new theory on the practice of adaptive management.

Whilst the bulk of detail about methods is included within this chapter, additional information is provided relating to the links between cases and the various themes of each research cycle in later chapters. Records of conversation and meeting plans and reflections, chapter drafts written during and after the completion of each learning cycle, and my research journal of ideas have provided records of my assumptions and interpretations made at the actual time these cycles were conducted. These records have aided in the development and practice of adaptive management from the theoretical deconstruction in Chapter Two. The use of action research to develop understanding about ways in which to support the practice of adaptive management requires actual cases in which to trial approaches to doing so (i.e., evaluation, joint inquiry and individual reflection on group process). Chapter Four provides a contextual background for cases used for these means in this research.

Chapter Four: Case study contexts

4.1 Introduction

Given my argument about the significance of context to the practice of adaptive management, this chapter provides an analysis of the context from which the case studies in this thesis were derived. All cases in this thesis involve collaboration, if not direction, from the Department of Conservation (DOC), the government agency with responsibility for managing, among other things, public conservation lands in Aotearoa-New Zealand. An understanding of the development of DOC and its mandate is essential to understanding the managerial context of the organisation and the implications this has for the practice of adaptive management. Whilst this chapter remains largely descriptive, it provides material relevant to the interpretation and conclusion drawn in subsequent chapters. The science directive involved in these cases and the alignment of specialist science support outside of the line management structure of DOC is of particular significance to the overall thesis conclusions.

This chapter begins by detailing the inception and evolution of DOC. It then introduces generic examples of adaptive management from within the New Zealand conservation sector. Practitioners involved in these cases are associated with the research presented in Chapters Five and Seven. Because the particular detail of these cases is not considered essential to the interpretation of data in those chapters, and because of a desire to protect the identity of participants (especially where data in subsequent chapters are more critical of organisational arrangements and processes), I chose not to provide detailed accounts of these cases. However, greater detail is provided in some of the cases. In section 4.3 of this chapter, I detail a selection of projects from which participants in Chapters Five and Seven were identified. I provide background on the Mainland Islands, a group of six cases from which participants provided data for the research presented in Chapters Six and Eight. Additional information is provided on the Adaptive Management to Restored Forests Affected by Deer project (FAD) which provided a second group of participants for the research presented in Chapter Eight.

4.2 Conservation in New Zealand

The Department of Conservation (DOC) manages public lands accounting for approximately 30% of New Zealand's landmass (in addition to 1% of New Zealand's marine Exclusive Economic Zone (Craig *et al.* 2000)). The management imperative associated with DOC is clear in legislation where conservation is defined as "the preservation and protection of natural and historic resources for the purpose of maintaining their intrinsic values, providing

for their appreciation and recreational enjoyment by the public, and safeguarding the options of future generations" (Conservation Act 1987). The formation of DOC in 1987 was deemed to represent the integration of disjointed and somewhat ad-hoc management of public lands and other resources, e.g., wildlife, by multiple government departments (Young 2004). Alternatively, its functional mandate has been viewed in light of neo-liberal reforms of the public sector that occurred under the Labour governments of 1984 and 1987 (Bührs and Bartlett 1993).

A preservationist mandate (such as that outlined in the Conservation Act) has been adopted in in New Zealand, given the high degrees of biological endemism and dramatic losses in both flora and fauna. Since first settlement (ca.1000 AD) some 55% of forests, 90% of wetlands (Craig *et al.* 2000) and 23% of native vertebrate species (Wilson 2004) have been lost in New Zealand. Currently, 17% of land birds and 23% of sea birds are considered threatened, many surviving only on off-shore islands (Wilson 2004). Key threats include introduced predators (Parkes and Murphy 2003), introduced herbivores and 240 species of weeds (Owen 1998).

More recently, the role of communities in conservation, and the ethos of those involved have been recognised (Young 2004). Within New Zealand, the concept of indigeneity is one that is frequently dealt with by means of ethnic categorisations of European (Pakeha) or Māori. These classifications are however debated given that a growing number of residents (both Māori and non-Māori) identify with the ethnic category of New Zealander or Kiwi (for more detailed discussion see Pearson 1989 and Callister 2004). In any case, the significance of Te Tiriti O Waitangi (arguably New Zealand's founding document), signed between Māori and colonial representatives, lies in clauses within legislature (including the Conservation Act) that state that they must be interpreted to give effect to the principles of Te Tiriti. This is however somewhat problematic given that two versions (one in English, one in Te Reo (i.e., the Māori language)) were signed and differed in translation. Without wishing to digress into what is a sensitive and debated topic within Aotearoa-New Zealand, two key differences in the translations relevant to conservation and the operations of DOC and the practice of conservation (including adaptive management) are of the words 'kawanatanga' and 'tino rangatiratanga'. The first is interpreted within the English version as all rights and powers of sovereignty over Māori and their land residing with the Queen of England, and the second that Māori retain undisturbed possession of their lands, forests, fisheries and other property. The Te Reo translations refer in the first instance to complete governorship of lands residing with the Queen, whereas the second instance is translated as the unqualified exercise of

chieftainship over lands, villages and other treasures[20]. In recent years, have begun a process of seeking compensation for grievances under the Treaty. For example the Te Rūnanga o Ngāi Tahu Act 1996 has implications for the practice of conservation given that it includes provisions for statutory acknowledgement. In particular, the explicit recognition of Tōpuni result in the 'overlay' of Ngāi Tahu values on specific pieces of land managed by DOC. In other areas (for example, Te Urewera National Park), a lack of progress on Te Tiriti settlements has affected relationships between the Crown (including DOC) and local (Coomes and Hill 2005).

Conservation interests of Pakeha (i.e., European New Zealanders) also have a long history, both in protection of significant areas of private lands, in conservation action, and in gifting of land and land management rights to DOC (Young 2004). Further, the role of Non-governmental organisations (NGOs) as protagonists in the formation of DOC, and as critics of policy and management since its inception, is significant.

4.2.1 Historical perspective

New Zealand's environmental legislation has a history almost as long as colonial law in New Zealand. In 1867, the first legislative act relating to the environment – the Salmon and Trout Act - was introduced. Between 1870 and 1905, in what Young (2004) classifies as "a dawning of awareness", forty new acts or amendments were introduced that were enacted by a range of government agencies. Species introduced to New Zealand by acclimatisation societies for the purposes of recreational hunting, especially deer and possums, were identified as early as 1909 as causing major environmental impacts to indigenous vegetation, and have lead to prolonged control operations led (at various stages) by the Department of Internal Affairs and the Forest Service (Caughley 1983), and more recently by the Animal Health Board and DOC. Concerns about the effects of the introduced Mustelid genus on native species of birds (for example the experiences of the pioneering conservationist Richard Henry on Resolution Island between 1892 and 1906 (Montgomery 1997)), led to the initiation of the Wildlife Service as part of the Department of Internal Affairs in 1947 (Galbreath 1993). A growing tourism industry, facilitated by the Department of Works and Services rail and roading developments, and encouraged by the then Department of Tourism also led to the development of many 'scenery' parks, tracks and huts by the Department of Lands and

[20] These translations are based on government sources (http://www.treaty of Waitangi.co.nz, accessed February, 2006). It should be noted here that the translations of these words is also debated and may differ from those presented. For examples of this debate, see Ross (1972).

Survey. Government conservation efforts were bolstered by the acquisition (through gifting by) of Tongariro and Mt Egmont (now Taranaki) national parks, in addition to Island sanctuaries including Hauturu, Kapiti, Whenua Hou and Tiritiri Matangi.

In the 1970s and early 1980s, a number of government-led activities of national level interest, including the proposed logging of forests near Maruia and Pureora, mining interest in South Westland and the planned development of a hydro-power plant between Lake Manapouri and Doubtful Sound led to calls for a more integrated approach to the management of the public conservation lands. These came to fruition in 1987 when the Department of Conservation (DOC) was formed, subsuming parts of the former Forest Service, Department of Lands and Survey, the Department of Internal Affairs Wildlife Service and some members from the Department of Scientific and Industrial Research (Young 2004).

4.2.2 Reformist perspective

At the time of DOC's establishment under the 1984 and 1987 Labour governments, public sector management in New Zealand was undergoing substantial reform. The reasoning for these reforms included a desire for increased effectiveness and efficiency in management, for accountability and responsiveness to the public and for decreased costs (Boston *et al.* 1991). At the time of the reform, Bührs and Bartlett (1993) suggest that there was a perception of state "vandalism" towards the environment, and that the dual goals of development and protection were akin to having "goats minding the cabbages" (*ibid*: 95). Unlike other departments affected by the reforms, DOC has remained something of an anomaly. It has retained roles of advocacy, ministerial advice, policy formation, delivery and regulation of the same services, and the production and consumption of specialist information (Hartley 1997) seen as conflictory under the reformist model (Boston *et al.* 1991). The avoidance of the implications of some of the public sector reforms faced by other governmental agencies has led to a view that the organisation is inefficient and ineffective, bureaucratic, and lacking in transparency in its decision-making and has no incentive to integrate its values with others' (Hartley 1997, Craig *et al.* 2000).

4.2.3 Recent perspective

Since its establishment, DOC has consolidated its strategic direction, increased its mandate (by legislative means), and has restructured multiple times in order to establish clearer lines of accountability, to better support management and to cut costs. One year after its formation,

DOC restructured resulting in the loss of close to 30% of its staff (DOC 1998b). In light of findings of a commission of inquiry in 1996 and a concurrent State Services Commission review, DOC was further restructured between 1996 and 1998. Comments from the newly developed position of Director General at the time of the restructure are indicative of the culture of the organisation – including that he did "not want to be known as the department of opinions" and that "the department is not there to lock up land" (DOC 1997b). The introduction of a three tiered line management structure supported at each level by service roles (including science and technical support) was designed to increase accountability and customer focus, and to further decentralise decision-making and increase strategic emphasis. Figure 4.1 depicts the resulting structure, including Regional Offices (three), Conservancy Offices (thirteen) and Area Offices. Within the line management structure, accountabilities generally follow key operational foci, including biodiversity threats, biodiversity recovery, visitor assets (including historic heritage), community relations and policy support (i.e., responsibilities under the Resource Management Act 1991). This model represents a compartmentalised managerialist model, whereby accountability is strengthened through administrative procedure within the line management structure.

In 2004 (during the course of this research), the Department faced further restructure. However, this restructure was limited to senior levels of management, including those levels aligned with strategy. A review of Regional Office and Science, Technology and Improvement Services unit (STI) (Ombler *et al.* 2004) indicated that reasons for restructure included improved support processes, fit with the organisation's strategic needs and the need to reduce costs[21]. In particular, this restructure removed responsibilities for national improvement from Regional Office managers and centralised them. As a consequence, strategic level science support was incorporated with STI and the unit was restructured in order to support functional work streams under the Statement of Intent. It was renamed Research, Development and Improvement (RD&I) (Ombler *et al.* 2004). The number of Regional Offices was reduced from three to two, the previous regional office managers were re-named Manager of Operations – North and South. Hence, the alignment of the line-management structure of some conservancies was shifted and the regional office responsibility for overseeing activities and the strategic direction of some initiatives (e.g., NRO in overseeing pest management) was removed.

[21] In the 2004 financial year, a $1.8 million deficit was recorded (DOC 2005b). The 2005/6 Department of Conservation Statement of Intent indicates a forecast deficit of $6 million for the 2005 financial year, and $19.5 million for the 2006 financial year (DOC 2005b).

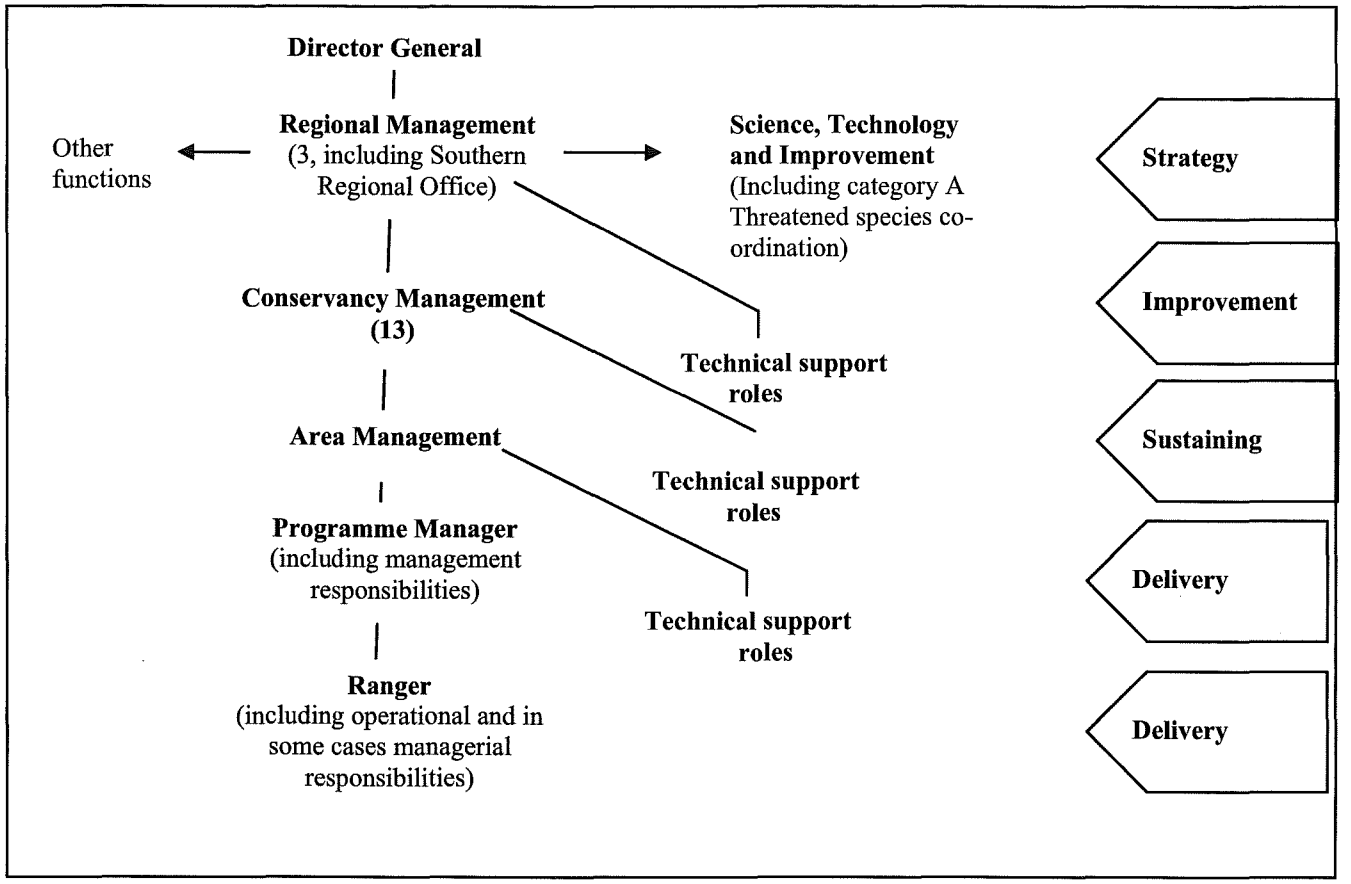

Figure 4.1. Management structure of the Department of Conservation prior to the 2004/5 restructure. These include functional roles within the line management structure (shaded) and outside of the line management structure. Shaded arrows on the right indicate hierarchical function.

4.2.4 Prospects for integrated approaches

The 1996-8 restructure resulted in the compartmentalisation of operational foci in order to ensure adequate accountability. As a consequence, roles of management and support were clearly distinguishable although the desire for management activities to be underpinned by credible science information remained. DOC has continued to respond to calls for more integrated biodiversity management, for example those that argue for strengthened science-management partnerships, strengthened public-management partnerships and shifting conservation focus beyond single species to include the systems that support them (e.g., Towns and Williams 1993, Craig *et al.* 2000, Clout and Saunders 1995 and Perley *et al.* 2001). A departmental emphasis on larger-scale and integrated approaches to management is evident in a desire for ecosystem management (e.g., Park 2000, DOC 1998c), for working with communities (e.g., Fitzgerald 1999, Forgie *et al.* 2001, Wilson 2005), and management

that is adaptive and underpinned by science (e.g., DOC 1997, Townsend 1999, Keedwell *et al.* 2002, and Saunders 2000). The practice of this integrated direction is evident in highlights of integrated and site-focused recovery models such as the Mainland Islands, Kiwi Recovery Programme and Operation Ark (DOC 1997b). This direction also fits with previous history of the Wildlife Service that is claimed to be world-leading in its innovation, especially with regard to species management (Galbreath 1993, Yeabsley and Duncan 2004).

An important part of the functioning of DOC is its relationships with tangata whenua and other community members. Within the management of DOC, this is brought to bear in the implementation of Kaupapa Atawhai and Conservation with Communities strategies. Further, the legislated establishment of Conservation Boards under the Conservation Act provides for independent advice on conservation activities at the regional level. These participation mechanisms thus provide a means of recognising the significance of knowledge, expertise and values held at the local level. However, integration of community interests, concerns, values and rights in management is not ensured given the separation of Kaupapa Atawhai[22] and advocacy functions from the line management structure. The success of integrated initiatives therefore depends on individual managers' perceptions of the significance of these aspects to management.

4.3 Adaptive management in the conservation sector

In comparison to the more limited number of adaptive management applications in the fisheries and agricultural sectors (see Chapter 1.2.2), the practice of adaptive management is easily identified within the conservation management sector. Adaptive management is recommended in the Department of Conservation policy on deer control (DOC 2001c), is suggested as a means of involving the public in conservation (Forgie *et al.* 2001) and is indicated as an appropriate approach for the management of both the endangered *Pittosporum patulum* (Townsend 1999) and Black Stilt (Keedwell *et al.* 2002). It is also deemed appropriate for the management of multi-species restoration projects such as the Mainland Islands (Saunders 2000). Whilst reference to adaptive management is common, a definition of the term is not included in the 'DOCtionary'[23].

[22] Kaupapa Atawhaui refers to a position within DOC with responsibility for facilitating consultation with (DOC 1996b).

[23] The DOCtionary, URL: http://www.doc.govt.nz/About-DOC/DOCtionary.asp) contains references to many of the terms and acronyms used by DOC in plans, reports and policy documents.

Adaptive management is an explicitly espoused management model, or considered a desirable management model in a number of projects involving DOC. These include:

- Determining the different conservation outcomes (i.e., canopy tree condition) of differently timed possum control operations in order to optimise their timing (Parkes *et al.* 2000);
- Management of Kokako - a critically endangered endemic species of bird (Innes *et al.* 1998);
- Management of braided river systems in the South Island (Brown and Sanders 1998);
- Management and research to restore forests affected by deer (Veltman *et al.* 2005);
- Management of tussock grasslands with a goal of promoting their long-term sustainability (Allen *et al.* 2001b);
- Enhancing the management capacity of conservation refuge (Burns and Robertson 2004); and
- Management of the Mainland Islands (DOC 2000b).

It is likely that adaptive management is also being practised implicitly or in a limited form elsewhere, for example in management of Thar (Ottman and Hughey 2004), in the form of co-management in the Kia Mau Te Titi Mo Ake Tonu Atu research programme (Moller 2000) and in the development of the management scheme for marine areas of Fiordland (Carey 2004).

Examples of adaptive management from the New Zealand conservation sector largely have an experimental emphasis. Whilst some projects explicitly link social and ecological systems (for example, the FAD project), others appear to separate these facets into experimentation and advocacy goals (for example the Mainland Islands), or are solely focused on experimentation (for example, the Kokako Management project). It is hence possible that adaptive management may be driven by profession and professional paradigm rather than the needs of a given context, as Roe and van Eeten (2002) argue is the case in the United States. A selection of the cases identified above is used in Chapters Five and Seven to further explore the practice of adaptive management in the New Zealand context. Further, two cases (Mainland Islands and Forests Affected by Deer), described in the sections that follow, provide more specific cases with which to explore emergent research themes.

Prospects for integration of both experimental and collaborative emphases of adaptive management (as outlined in Chapter Two) depend on a number of factors. Within references

to the facilitation of community initiatives, the potential contribution of a range of stakeholders in exploring management concerns, objective setting and in providing 'local' and indigenous knowledge is recognised (Forgie *et al.* 2001). The underpinning of management by science inherent in adaptive management may be problematic given the position of science support outside of the line management structure raises questions about the effective uptake of science information, and may lead to informal models of science support (Wright *et al.* 2003, Ombler *et al.* 2004). Thus, the more formalised participation of sources of both local, indigenous and science knowledges and values is hence likely to be most successful at a decentralised and project specific level given the tangibility of management at this level (Forgie *et al.* 2001). As such, an action research approach is an appropriate way to explore such integration.

4.4 The Mainland Islands

The Mainland Islands can be viewed as an attempt to mirror, on mainland New Zealand[24], the successful management of threatened species on off-shore islands and consolidate achievements in projects such as Project River Recovery and the Kokako recovery efforts at Mapara Reserve (Parkes and Murphy 2003, Saunders and Norton 2001, Saunders 2000a). The projects are credited with developing capacity in operational techniques, contributing to the understanding of ecosystem components and their interactions, and building public and inter-agency support and involvement in conservation, in addition to making substantial gains in biodiversity conservation (Saunders 1999; 2000a; Saunders and Norton 2001).

Mainland Islands are large areas intensively managed to control the threats to indigenous biodiversity, surrounded by an otherwise un-managed area, be it forest fragment surrounded by farmland, or forests surrounded by un-managed forest. Many areas managed by DOC fit this description. However, only six projects contribute to the Mainland Islands management unit reported on within DOC (see DOC annual reports from 1997 (DOC 1997b)). Saunders and Norton (2001:110) distinguish other projects on the basis that they "are essentially aimed at rehabilitating habitats and recovering suites of threatened species rather than restoring ecosystems per se." The six Mainland Islands are Hurunui Mainland Island (HMI), Rotoiti Nature Recovery Project (RNRP), Paengaroa Scenic Reserve (PSR), Boundary Stream Mainland Island (BSMI), Northern Te Urewera Ecosystem Restoration Project (NTUERP)

[24] The term 'mainland' is commonly used in New Zealand to distinguish the two largest islands (i.e., the North and South Islands) from other out-lying islands (for example, Rakiura (Stewart Island) and Rekohu (Chatham Islands)).

and Trounson Kauri Park (TKP) (Fig. 4.2) were initiated in 1995 and 1996 as part of additional national-priority funding made available by the New Zealand Government to DOC (Saunders and Norton 2001), although from 1997 they were funded from Conservancy budgets (Shaw 1998).

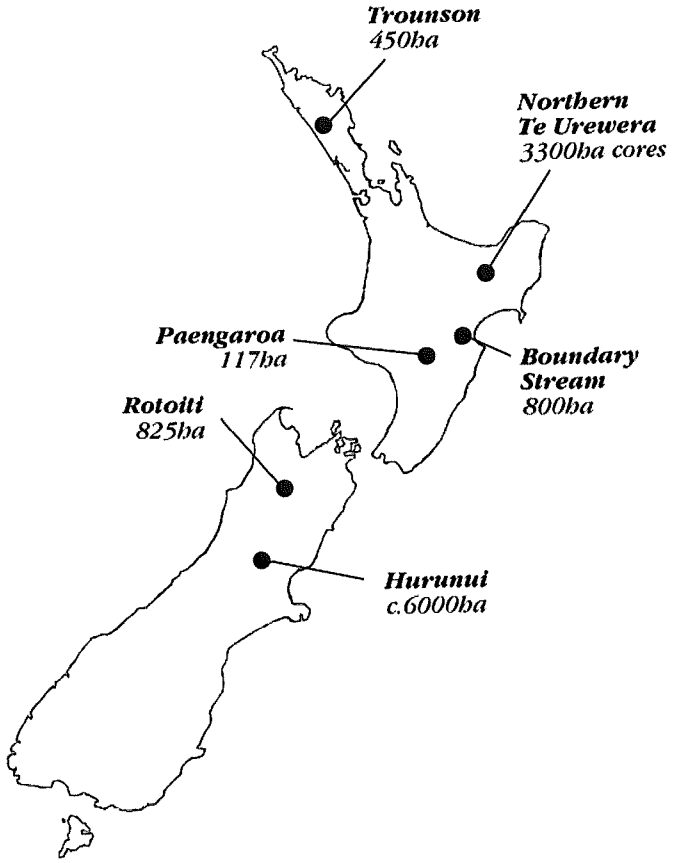

Figure 4.2: Map of New Zealand showing the location of the 6 Mainland Islands in relation to the key centres (reproduced and adapted from Saunders 2000a).

Mainland Island projects were selected by DOC in relation to a number of ranked criteria including uniqueness of biotic assemblage, representation of existing indigenous ecosystem types and importance to threatened species (Saunders 2000). Further, proposal quality was assessed on predicted biodiversity benefits, predicted benefits from technique development, project risks, cost benefit analysis, opportunities for advocacy, and scientific soundness. These criteria included somewhat counter-intuitive desires for high levels of return yet few risks, and high levels of return and scientific rigour yet relatively low costs. The selection criteria also indicated an emphasis on individual species despite the supposed integrated ecosystem-oriented emphasis (*ibid*).

In addition to substantial differences in size (from 117 to 6000ha), variation exists between the projects in terms of their ecological characteristics. Some are remnant forest patches surrounded by production land, whilst a mix of forest, lake, privately owned land and production land surround others. Types of forests also vary from Beech (*Nothofagus* spp.) to podocarp/broadleaf mixes. An array of different combinations of threats *and species* are managed at different sites. Managed threats include a combination of cats, rodents, deer, pig, possum, mustelids, wasps and weeds. Managed species include birds (e.g., Kaka, Kokako, Kereru, Mohua, Parakeets, Kiwi, Robin, and Whio), insects (including Weta and Honey Dew Scale insect), mammals (i.e., bats), snails, and plants (Rata, Mistletoe, Kakabeak, Grass tree, Tree Daisy and Woodrose) all of which are either threatened in the areas or are significant in the healthy functioning of the ecosystems of concern. It should be noted that the operational management of similar threats and the monitoring of similar outcomes differs between the projects, demonstrating a lack of standardised operation (Saunders 1999). These differences are significant in that they influence the potential use of adaptive management as either a site-focussed management model or a nationally replicated experiment (see Chapter Six for further discussion of this).

The Mainland Islands also differ in administration and management. Costs vary from $25 000 to $305 0000 per annum (Saunders 1999). To date, there has been only one comparison of costs in relation to outcomes (Cullen *et al.* 2005) although this was focused on conservation outcomes of different species given that these were the quantifiable component of the goals of some projects. Planning and reporting are not standardised across the projects (Saunders 2000a). Further, involvement of stakeholders (including research organisations) is disparate between projects[25]. Before the 2004/5 restructure, responsibility for strategic direction of the projects rested with the Southern Regional Office, with technical support from the STI and the Biodiversity Recovery Unit (BRU). A specialist co-ordination position (hosted within STI) also existed between 1999 and 2004. After the 2004/5 restructure of STI, strategic direction for the Mainland Islands moved from Southern Regional Office to the Research, Development and Improvement Division, which also subsumed the BRU. Staff at the Area Office level have responsibility for planning, operationalising and managing the projects, with access to support as per the line management structure. Because of the substantial differences between the projects, Mainland Islands staffing and support levels also vary. Within the conservancy management structure, projects compete with other DOC projects for funding. The Mainland Islands are, in comparison to other projects, much more intensive in scope of management

[25] Input from research providing stakeholders is discussed in Saunders (2000a:125).

and extent of monitoring, requiring far larger operational budgets and staffing resources. Links with non-Mainland Island projects are also varied and are precipitated by staff movement. During the period of this research (i.e., 2001 – 2005), each Mainland Island had changes in the programme manager role. Others have lost technical specialists from ranger roles. This represents a substantial loss of knowledge, institutional memory and experience from these projects.

In 1999 and 2000, the Mainland Islands underwent review (Saunders 1999; 2000a; 2000b). The review indicated that whilst the primary criterion for their selection was threatened species conservation, the projects provided a multiplicity of benefits as indicated in their long-term strategic plans, including advocacy opportunities, research, knowledge sharing and species reintroductions. Importantly, the broad and ambitious goals of the projects and a lack of experience within DOC at managing mainland restoration activities of this scale resulted in the acknowledged need to manage both innovatively and in an experimental fashion. In addition, because of the nature of their boundaries, most of the projects have sought local support for the activities they undertake.

Review documents signify that the management of the projects was lacking in strategic direction and thwarted by capacity issues. Recommendations from Saunders (2000a) indicate a desire for increased strategic and operational policy directive of ecosystem-oriented restoration activities, for co-ordinated planning and reporting across the projects and in other aspects of management including their show-case function, for exploration of collective research needs to support restoration activities, and lastly, for the consideration of a national restoration experiment in order to meet nationally significant capacity requirements. Importantly, recommendations indicate that the Mainland Island projects were now being considered alongside other similar restoration activities. Whilst each project initially innovated as appropriate to its context, the recommendations indicate a desire to rationalise and compartmentalise the functions of mainland conservation projects. Thus, the reviews have created a picture of two opposing positions on management of the projects that could impinge on opportunities for adaptive management. They include the picture of the emergent, context-driven innovative but rogue project, and that of a team-playing project whose activities are potentially limited in local relevance.

In addition to reviewing previous activities, the reviews highlighted future management options. Within the review, substantial detail was directed at the potential adoption of

adaptive management. For example, Saunders (1999:2) states that "adaptive management is recommended as the most appropriate approach... to reduce uncertainty and develop sustainable management regimes". Elsewhere in the literature it is indicated that the Mainland Islands are already practicing adaptive management. The 2000 DOC annual review (DOC 2000b:110) clearly states that the Mainland Islands are areas "where ecosystem restoration goals are being pursued using an experimental adaptive management approach". Thus, whether or not the Mainland Islands were or are using adaptive management, and if so, to which model (i.e., PAM or AAM) is difficult to discern. The answer to this question may, in part, be dependent on how adaptive management is interpreted.

Saunders (1999) suggests that adaptive management enables a more systematic approach to management that enables constraints to be evaluated and as a sound basis for decision-making. Saunders and Norton (2001:117) note that "Employing an adaptive management approach may allow for a balance to be reached between the need to actively intervene to prevent further declines, and a need to enhance our understanding of ecosystem processes". Adaptive management is recommended as the most appropriate approach for reducing uncertainty in management and developing sustainable management regimes (Saunders 1999). Both scientific and social interpretations of the approach are evident. For example, statements which suggest that adaptive management "...allows scientific rigour to be combined with management uncertainty and complexity" (Saunders 1999:18) exemplify the experimental emphasis, whilst suggestions that adaptive management be viewed as "...a win-win process by which managers are able to continue management, researchers are able to undertake large-scale experiments, policy makers to hedge their bets by trialing several options, and stakeholders to influence decisions and to participate in the process of management" (*ibid*: 156) exemplify a collaborative emphasis. However, these aspects seem to be overlooked in comparison to the scientific proviso. Further, the exploration of these issues in pivotal works, including that of Holling (1978) and Walters (1986) is excluded from descriptions. Further works by those authors are also excluded, including Gunderson *et al.* (1995) and Walters and Holling (1990). Thus, references to adaptive management in documentation relating to the Mainland Islands represent a form of research by experimentation (the quality of which has been challenged (Saunder 2000b)), rather than management that integrates social, scientific and managerial perspectives and values as relate to a given context. Hence, the reviews lack discussion of context features that may impinge on the way that the approach is applied, or the changes that will be required for current management to become adaptive, if it is not already so.

Whilst a scientific-oriented species management focus was clearly the desire when initiating these projects (Saunders 2000a), the retrospective fitting of adaptive management to current Mainland Island projects requires further examination. Clearly, there is a need to attend to interpretive and contextual issues if the application of adaptive management in these projects is to occur more widely. Use of these case studies presents timely opportunity to develop understanding about adoption and practice of adaptive management in pre-established projects. Unlike Mainland Islands, the FAD project was specifically designed and implemented as an adaptive management project.

4.5 Adaptive Management of Forests affected by Deer

Since their first liberation in New Zealand in 1854 (Caughley 1983), perspectives on the management of deer have come to be characterised by two disparate positions: resourcism (i.e., the view that deer are a resource) and preservationism (i.e., the view that the retention and restoration of indigenous biodiversity over-rides any other arguments about the value of introduced biota) (DOC 2001, Eggleston 2002). In researching historical perspectives towards deer in New Zealand, Eggleston (2002) identifies the progression of pakeha cultural development in regards to the environment from re-creation of home (in the 1800s), through to the development of pakeha nationalism, including the awakening of values associated with indigenous aspects of the new home (early 1900s), and on a period of active and restitutive management of the environment (mid 1900s to today). Over time, deer numbers have soared, peaking in the 1940s, and then declining (Yerex 2001).

The liberation of deer into the New Zealand landscape was first managed through legal protection before being licenced. As deer numbers increased, payment for hunting licences was removed. The supposed influence of deer on soil erosion, vegetation regeneration and fodder sources for domestic sheep resulted in the instigation of a policy of deer eradication under the Animal Protection and Game Act (1921), and then the Noxious Animal Act (1956) (Eggleston 2002).

The introduction of the 1977 Wild Animal Control Act recognised that the goal of eradication was problematic, and hence that the support of recreational hunters and a developing commercial wild venison industry was essential for future control efforts. The legislative 'noxious' label for deer was removed, and the National Recreational Hunting Advisory Committee was established as a means for hunters to control deer in areas of lower ecological

value (Eggleston 2002). Whilst this committee was disestablished in 1989 as part of the New Zealand state sector reforms, the established recreational hunting areas remained. Hunters were also formally recognised in control collaborations, including in the management of Wapiti (*Cervus elaphus*) in Fiordland National Park from 1954 to 1965 (Eggleston 2002).

In 2001, DOC published its Policy Statement on Deer Control. The policy statement was deemed to mark "the end of a period of consultation on deer management that began in 1997" (DOC 2001c). This consultation phase involved the publishing of a public discussion document on "the issues and options for managing the impacts of deer on native forests and ecosystems" (Cole 1998), which provided a focal point for debate on the management of deer. The purpose of the document was "to determine what tools will be used to minimise the damage to our native ecology and how the legitimate interest of recreational and commercial hunters can best be managed" (*ibid*:v). However, whilst some perceive that the ensuing policy statement did little to incorporate the perspectives of hunters suggested by this statement (Eggleston 2002), the legislated responsibilities of DOC have been clear throughout the process. The Ministerial foreword to the discussion document clearly outlines that the objective of DOC "must be maintaining the biodiversity and structure of our native forests" (DOC 1997). The potential contribution of hunters was also made clear in that it was deemed "acceptable providing the Department's ability to supplement it is not constrained" (*ibid*).

The analysis of submissions on this discussion document (Cole 1998) highlighted the resourcism and preservationism perspectives on deer, but also emphasised commonly held perspectives. These included that priority setting criteria were generally or partially accepted by most submitters, and that more research was needed, particularly in relation to deer impacts. Submissions also indicated that amongst the science community, there was debate about the generalisability of studies on the impacts of deer on forests, and a desire for research "involving user groups in design, data collection and interpretation" (*ibid*: 1000), in addition to the previously identified need for research that enabled management to adjust control levels in relation to vegetation response (DOC, 1997a).

A recent evaluation of ungulate policy making in New Zealand scored the quality of the 2001 policy statement as 18/50, the lowest of all ungulate policies evaluated (Hickling *et al.* 2003). However, the evaluation did indicate that its strengths lay in the area of adaptive management. Of particular note is that the policy statement also includes the directive that "an adaptive management approach will be needed to allow control to be varied in response to the observed

effects of management". This policy directive led to the establishment of the DOC research programme called Adaptive Management to Restore Forests Affected by Deer project. This project involves scientists, managers and interested forest users in the "experimental design, overseeing the work, and interpreting the results" of an adaptive management project with the aim of understanding the contribution of deer control to protecting ecological processes in forests (DOC 2005c), and has the potential to address concerns raised by Hickling *et al.* (2003).

The project was established in 2003, with a duration of eight years and involving four study sites managed on a case-by-case basis. The directive of management research in these projects is guided by learning groups involving scientists, managers and interested forest users. Outcomes of the study are that "DOC will have a better understanding of how the four forested sites can change in response to deer control", and "a framework for doing adaptive management in the future" (*ibid*).

My thesis research interest in this project (Chapter Eight) was in regards to the ability of such a group to co-operate in a way that supported both individual and group learning outcomes given the disparate perspectives that have emerged through historical management of deer in New Zealand, and their subsequent perceived lack of accommodation within the policy statement itself. In particular, I was interested in the reflections of individuals on their experiences of adaptive management including the ability of such a project to meet their expectations, what they learnt as a consequence of being involved, and whether this information could be used to tailor a more reflexive group process. Research linked to FAD involves members from three learning groups; the fourth group was not finalised at the initiation of the research.

4.6 Chapter Conclusions

Case studies outlined in this chapter are all derived from the New Zealand conservation setting. An understanding of this setting, in particular DOC and its mandate are essential in understanding the managerial context of these case studies. DOC has emerged from its previously subsumed departments[26] and the restructuring that drew attention to its lacking accountability structures to be distinguished alongside other government departments for its

[26] When I first worked for the department in 1996, my manager introduced himself indicating that he was of forest service stock. Through aging, the department seems to have lost these lines of attachment to previous departments.

'innovations' in these things (Yeabsley and Duncan 2004). Unfortunately, the responsibilities required to make improvements in performance accounting and the likely nature of support mechanisms poses risks to the integration of perspectives that enable adaptive management to be reflective of the needs of a given context, and to effectively utilise science to enable institutionalisation of adaptive learning processes and adaptive management.

In order to work in a way that leads to improved reflection on the context of practice, the assumption that polarisation of perspectives on adaptive management evident in the literature also exists in practice needs to be checked. The following chapter does that by providing a scoping study of practitioner perspectives on adaptive management in New Zealand.

Chapter 5: Perspectives on the practice of adaptive management in New Zealand

5.1 Introduction

In chapter two of this thesis, I highlighted differences in the interpretations of adaptive management and the emergence of two divergent discourses on its practice, i.e., experimental and collaborative. Case literature from the New Zealand conservation management context (presented in Chapter Four) indicates that projects typically have a strong experimental emphasis, with little concern for the collaborative context of practice. This adds weight to the argument that reflection on context is required to avoid paradigmatically biased application.

The aim of this chapter was to determine if the same emphases of adaptive management evident in the literature highlighted in Chapter Four were an accurate reflection of the practice of adaptive management in New Zealand or if they merely represented bias in material presented in publications and reports. By presenting an analysis of practitioners' reflections on adaptive management (see Chapter Three for more methodological detail), the scoping study presented in this chapter highlights that whilst polarisation in perspectives exists, the significance of learning as a central tenet of adaptive management has not gone amiss. Thus, the chapter provides impetus for further development of the formative evaluation framework outlined in Chapter Two.

The first part of this chapter presents emergent themes from practitioners' descriptions of their experiences of adaptive management. Data was collected from 11 semi-structured interviews with practitioners explicitly practicing adaptive management. Data from interviews with Iwi representatives involved with co-management projects that could be considered adaptive in their nature are also included. This was justified, as outlined in Chapter Four, given the significance of Māori as a Treaty partner in New Zealand. The second part of the chapter considers limitations of these descriptions and reflections on the potential value of participatory evaluation on adaptive management. Practitioners' discussion of their projects resulted in the conclusion that further development of the framework was justified and therefore provided an opportunity to re-consider the framework structure. A summary of the analytic process is provided in Figure 5.1.

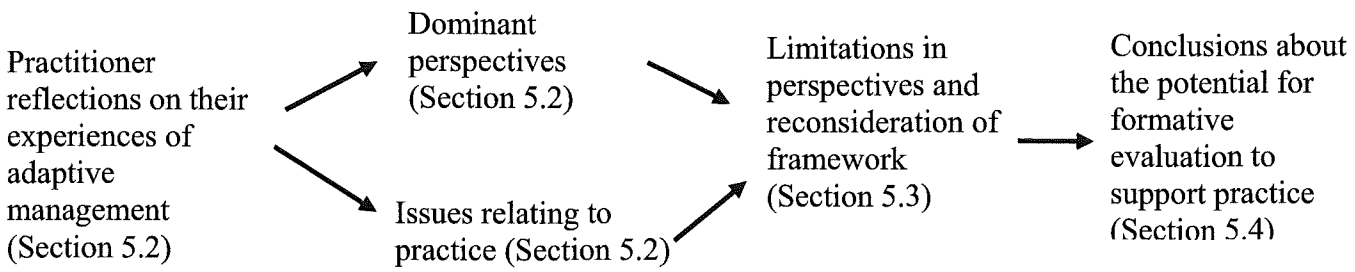

Figure 5.1: Analysis schematic for the chapter

5.2 Experiences of adaptive management

Research participants' perspectives on adaptive management included a number of common themes and a number of additional themes that enabled me to differentiate between different types of perspectives. Similarities between the themes are first presented, followed by the differences.

Participants responded to questions about their interpretation of adaptive management by identifying a number of central themes, several of which were shared. The following themes relate to philosophies underlying adaptive management:

- Adaptive management involves learning that is systematic;
- Adaptive management is about increasing capacity to manage;
- Increases in both the temporal and spatial scale of management affect the complexity of ecological and social systems, and can influence the success of adaptive management; and
- Adaptive management can empower people and increase collective capacity by increasing individual skills, allowing for innovation, and for various 'undermined' voices to be heard.

Some participants interpreted adaptive management in a very specific sense (i.e., involving a limited, scientifically oriented definition and for application in a limited set of circumstances), whilst others suggested that its interpretation needed to be broadened (i.e., to include social aspects) in order for practice to be successful. The key terms used and central themes

presented tended to represent the various interests and constraints (academic and other) of the participants in their professional roles. For example, scientific experimentation was a central theme in ecological scientists' discussion, resources were a concern for managers, whilst incorporating a diversity of perspectives was pertinent to Māori and others involved in working with the public. Themes from the interviews are presented in Figure 5.2. The three perspectives represent key themes from interviews. Note that individuals may have raised themes from within multiple perspectives, but the majority of their views tended to be based in one of the three perspective types.

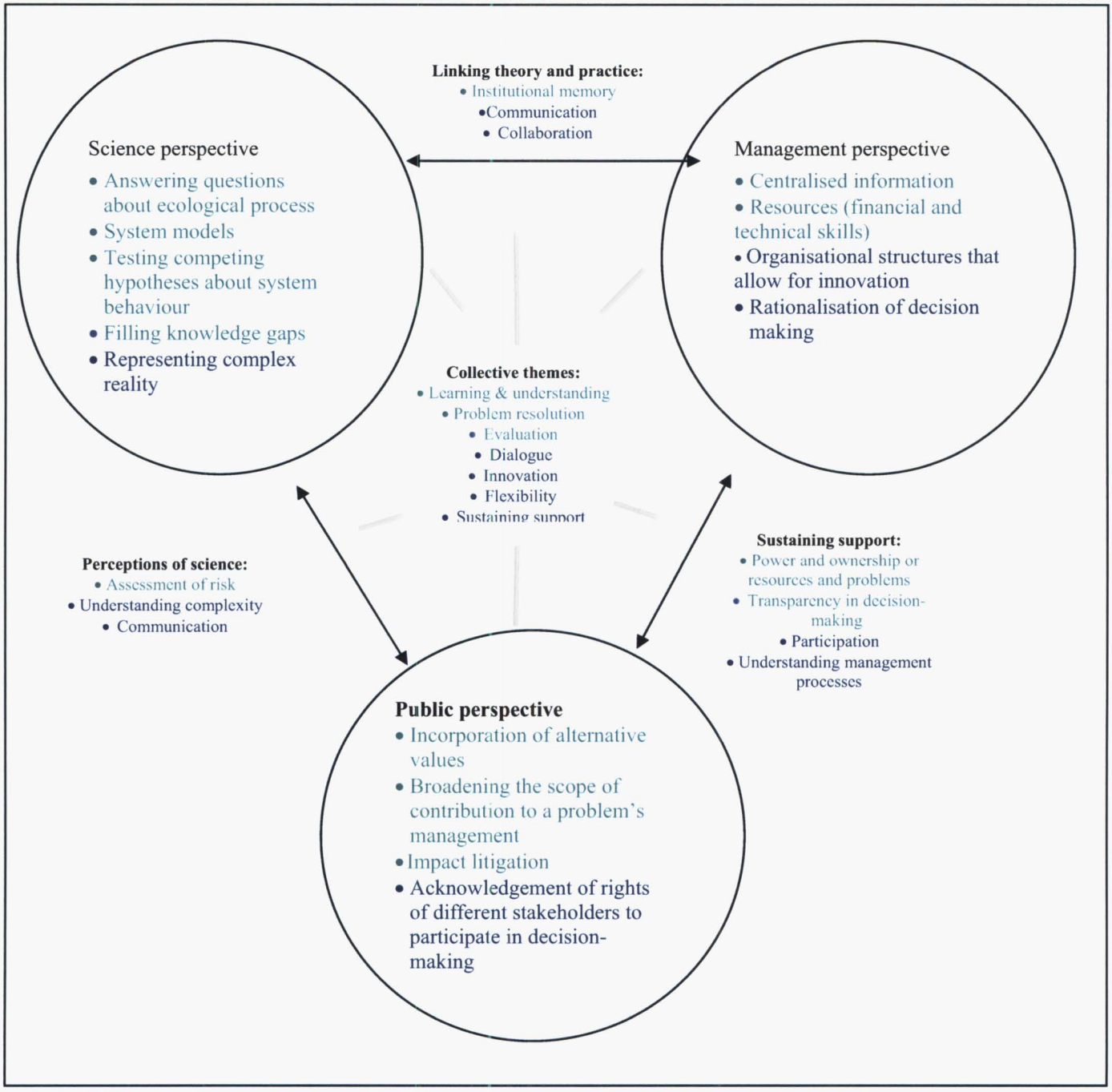

Figure 5.2: Clustering of themes identified in practitioners' perspectives on adaptive management. Themes coloured blue represent process themes; themes coloured teal represent outcome themes.

Participants differed in their focus on outcomes of adaptive management (for example learning and understanding) and the processes that support them (for example, dialogue). The number of outcome-orientated themes raised in the interviews (coloured teal in Fig. 5.2) far outnumbers the number of process orientated themes (coloured blue in Fig. 5.2). The importance of the differences between focus on outcomes and process is that the emphasis on outcomes suggests people know what outcomes need to be achieved (i.e., in order to "be doing adaptive management"), but may be less aware of the processes required to achieve those outcomes.

An additional difference between the perspectives was that some participants viewed adaptive management as a one-off process, as opposed to an ongoing process, and others emphasised the use of adaptive management as a pre-planning tool. Participation was also an aspect upon which there were differences of opinion. Some participants said that the participation was about sharing decision-making responsibilities (i.e., power sharing), whilst others suggested participation was important, but did not include sharing in decision-making responsibilities. Further, participants' reflections on whose values ought to be satisfied by participatory processes differed. Some suggested that representation of commonly affected stakeholders within the adaptive management process is important, whilst others suggested that all affected stakeholders should be represented.

Whilst I sought to identify the distinctiveness of adaptive management and Mātauranga Māori, responses from Māori participants focussed on additional issues that need to be addressed with this stakeholder group if adaptive management is to be successful. Collectively, participants recognised the need for sustaining support as a feature of adaptive management. In particular for Māori, participation in management initiatives and the practice of Kaitiakitanga were viewed as constitutional rights. Māori participants suggested that a lack of recognition of Te Tiriti, especially of the Māori translation and the fact that some rangatira (Iwi chiefs) did not sign Te Tiriti has led to a lack of recognition of the right of Māori to participate in environmental management decision-making processes (for a more detailed discussion of this relationship, see Chapter 4.2). A lack of centralised information in areas where multiple organisations have legal responsibilities is also noted as affecting the ability to meet responsibilities, including that of Kaitiakitanga.

Research participants also identified a number of concerns about the practice of adaptive management in New Zealand (Fig. 5.3) that can be depicted in relation to each of the perspectives previously identified. Whilst those falling within the science and management perspectives are similar to themes identified in the literature, issues relating to the participation of stakeholders may be more specific to New Zealand, given issues associated with Te Tiriti and their settlement.

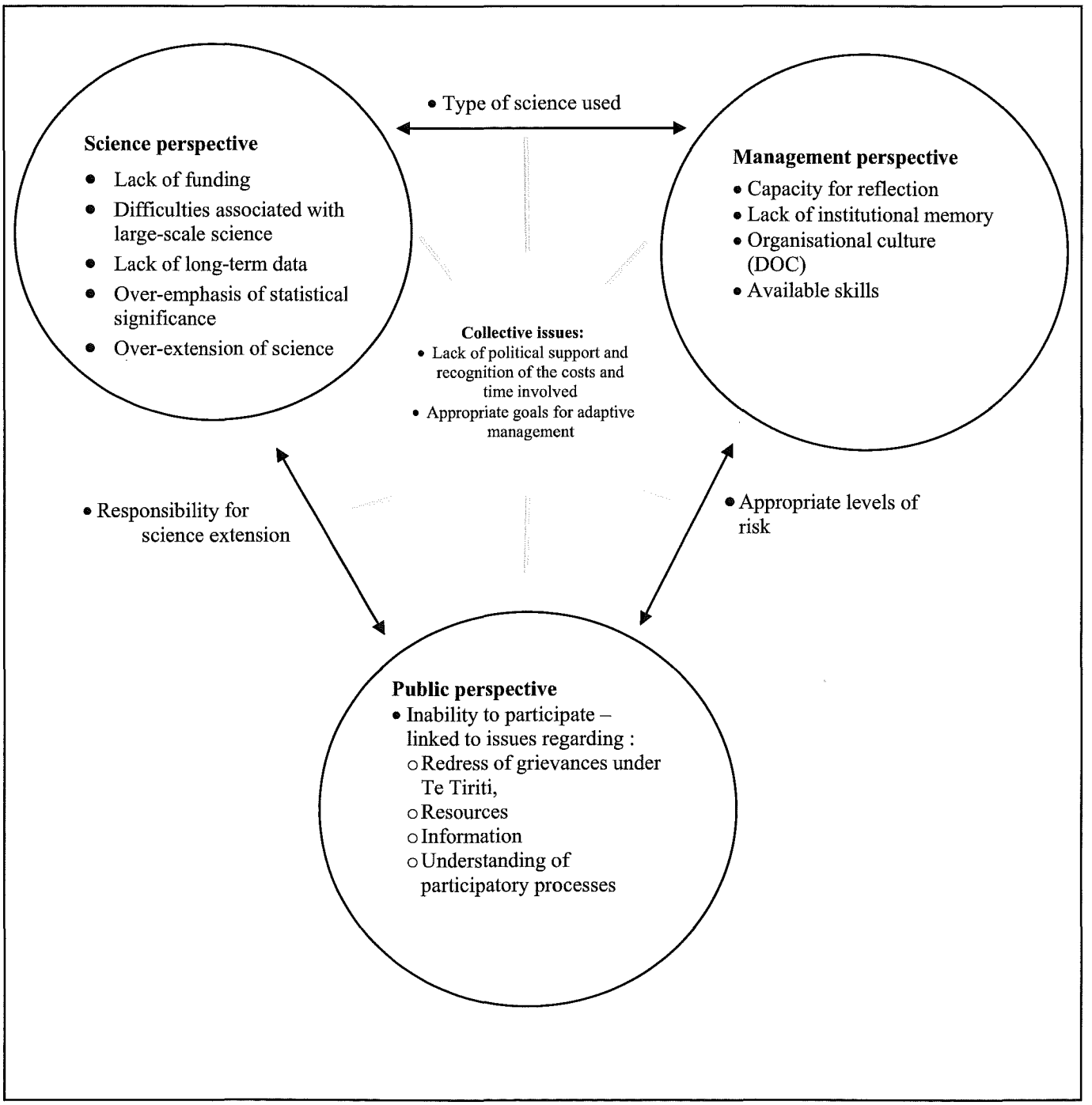

Figure 5.3: Themes identified by practitioners as issues relating to the practice of adaptive management in the New Zealand context.

5.3 Strengths and limitations in knowledge

Participants' reflections on their experiences as practitioners of adaptive management revealed many factors significant to the practice of adaptive management which were regularly mentioned (i.e., by at least six participants). These included the participation of managers in adaptive management, the cyclic nature of the learning process involved, the need for long-term commitment that considers the dynamics (both spatial and temporal) of the system under management, the need to recognise uncertainty and be willing to take risks to support learning, and the need to focus on providing information that is biologically significant. These reflections are significant in that they indicate that adaptive management is recognised as a learning-centred activity designed to support management in instances where uncertainty exists (Holling and Meffe 1996, Gunderson *et al.* 1995).

Whilst the clustering of themes relating to adaptive management was expected, given that participants were identifiable as specialists within their own fields, I also expected that from experience with adaptive management, processes relating to the integration of different disciplinary perspectives and their importance in adaptive management would be acknowledged. However, most participants failed to raise or emphasise themes relating to the integration of science, management, and public perspectives within development of adaptive management that is viewed, in the international literature, as pertinent to the practice of adaptive management (Light and Blann 2000a, BCFS 1997, Allen 2001). These limited perceptions support the notion that knowledge and understanding of adaptive management in New Zealand is polarised and adds weight to the argument developed in Chapter 4.3 that its practice appears to be influenced by profession and professional paradigm.

The relevance of this argument becomes clearer when we consider how these perspectives may influence an adaptive management programme. Assuming that not all participants will have equal input and influence on any adaptive management programme, and interviewees did rate their influence and input differently, projects contemplating its use will likely bound their understanding and knowledge of adaptive management in different ways. Depending on whose expertise is sought, projects may be left with a seemingly unachievable vision because of a lack of identification of processes that best support the outcomes they identify as goals. Without integration of differing perspectives, and identification of processes that support this, the practice of adaptive management may be inefficient, ineffective and narrowly interpreted.

Collectively (i.e., in three or fewer cases), participants regularly failed to note that management objectives that are part of adaptive management should be framed as testable hypotheses (Walters and Holling 1990). Other surprisingly neglected aspects included the need to link research and decision-making (Holling 1978). In contrast to often noted significance of learning and the management of uncertainty, this neglect comes as somewhat of a surprise, and supports the notion that whilst the purpose and outcomes of adaptive management might be understood, the processes required to achieve outcomes are overlooked.

An important point of disagreement in perspectives shared was the scale of interest in the application of adaptive management. Two participants noted that adaptive management was a model of site-based management, whilst two suggested that it did not need to be applied in a site specific way. Whilst this is also evident in different examples from within the New Zealand context (see Chapter 4.3), it has implications for the practice of adaptive management as either a site-based management model of 'management by research' as is suggested by Walters (1986), or a multi-site management 'research by management' model, as is suggested by Possingham (2000). These implications include the ability to include and incorporate perspectives such as those of that are relevant at the local level.

5.3.1 Reflections on the framework

Given the apparent limitations in knowledge of adaptive management and evidentially disparate perspectives on its practice, further development of the framework presented in Chapter Two for use as part of a formative evaluation was considered a useful next step in the research. My observations of the ways in which practitioners discussed their experiences of adaptive management revealed that the framework categories that I had proposed in Chapter Two served to emphasise collaborative and experimental discourses as they related to separate parts of adaptive management, rather than to integrate them as I had intended. As a result of this, framework criteria were re-organised around the steps of the management process as per Figure 2.1, Chapter Two, rather than being organised around parts (i.e., process, implementation and evaluation). Table 5.1 outlines the changes in category organisation.

Table 5.1: Framework re-structuring, showing criteria origination (Chapter 2)

Category	Criteria	No. criteria	New category	No. criteria
Learning	Double loop learning	5	Learning	12
	Experiential	2		
	World-view	5		
Process	Participation	3	Step1: Problem scoping	26
	Process	2		
	Collaborative management	10		
Implementation	Goal setting	11		
	Model development	9	Step 2: Model building	9
	Option development	2	Step 3: Action	22
	Decision making	13		
	Planning and implementation	7		
Evaluation	Monitoring	5	Step 4: Monitoring	5
	Evaluation	8	Step 5: Evaluation	8
Total		82		82

Given that learning was viewed as an inherent over-arching factor central to the world-view of adaptive management, it remained as a separate criteria category.

5.4 Concluding comments

Collectively, many issues significant to the practice of adaptive management were raised by participants in this study. However, individual knowledge was, in comparison, limited. The apparent differences in practitioner perspectives on the practice of adaptive management pose risks for projects new to adaptive management. If perspectives such as those presented are taken on by others considering the use of adaptive management as an alternative to current management, then New Zealand is at risk of re-inventing the wheel, and failing to learn from international experience with adaptive management.

Whilst many barriers to adaptive management identified within the New Zealand context are similar to those identified internationally, the relationship between the Crown and Māori, and the implications for participation in decision making may be a novel consideration for the practice of adaptive management in New Zealand. The existence of Te Tiriti, a document signed between colonial representatives and Māori, granted retention of land rights and other rights to traditional practice by Māori (for detail, see Chapter 4.2). Reflections of participants in this study echo those identified by others (e.g., Coombes and Hill 2005) that the participation of Māori at a local level may be affected by the state of relations between iwi and the Crown at both regional and national levels. As Coombes and Hill (*ibid*) suggest, it is often assumed that the non-participation of iwi at the local level represents a form of cultural hypocrisy. An alternative position noted by participants is that the associated responsibilities of being Kaitiaki are limited in practice by the lack of recognition of Tinorangatiratanga and the role of Te Tiriti grievance settlements.

These findings provide impetus for further development of formative evaluation, given that it has the potential to support reflection on the less considered aspects of its practice, and of the way in which both social (i.e., public) and experimental (i.e., science) perspectives relate to each step of the adaptive management process. Chapter Six builds on the findings of this chapter by exploring individuals' perspectives on adaptive management and its use in the management of Department of Conservation Mainland Islands. As such, it provides a more illustrated example of problems associated with different perspectives on adaptive management. It also provides an opportunity for further refinement of the framework to a state where it can be used to support reflection on practice that attempts to help practitioners identify for themselves the benefits of a more integrated and holistic interpretation of adaptive management.

Chapter Six: A revised framework for reflecting on the application of and capacity for adaptive management

6.1 Introduction

In this chapter, I present the second step in the development of a framework designed to be used as part of a formative evaluation exercise on adaptive management. This chapter builds on the notion of polarised emphases on adaptive management evident in Chapter Five. The cases used to do so are the Department of Conservation (DOC) Mainland Islands, a group of projects where the extent of practice of adaptive management is unclear. Whilst some documents claimed adaptive management is used in these projects (DOC 2000b), others describe current management as a 'research by management' approach (e.g., Saunders 1999), ignoring management process issues that could influence the success of adaptive management as an operational approach to the management of these projects. Thus, this cycle of research served two purposes: to elicit reflection on the potential for adaptive management in the DOC Mainland Islands, and in doing so, to determine the usefulness of criteria developed from the literature review (presented in Chapter Two and re-ordered in Chapter Five) for evaluating reflections on the use of adaptive management. The resultant analysis of adaptive management and the Mainland Islands highlights two options for more full and formal adoption of adaptive management: 'research by management' and 'management by research'. This analysis provides the impetus for developing the evaluation framework from a series of criteria to a question-based framework designed for gaining more in-depth reflection and structuring debate on the use of adaptive management.

I explored reflections on adaptive management and its potential practice at the Mainland Islands through 17 semi-structured interviews. Participants included staff involved with Mainland Islands at a range of different levels from strategic direction to operational management (for more background on these cases, see Chapter Four). Participants were asked to describe adaptive management and how it was applied to projects they were most closely associated with. I then asked follow-up questions related to the over-arching learning process and the five steps in adaptive management (see Chapter Two, Figure 2.1).

The first part of this chapter presents the results and a discussion of the implications of these reflections. The second part of the chapter presents the framework in question format

designed for use as part of formative, participatory assessment and details how these questions were derived from the criteria presented in Chapter Two, and reframed in Chapter Five. A summary of the analytic process is provided in Figure 6.1.

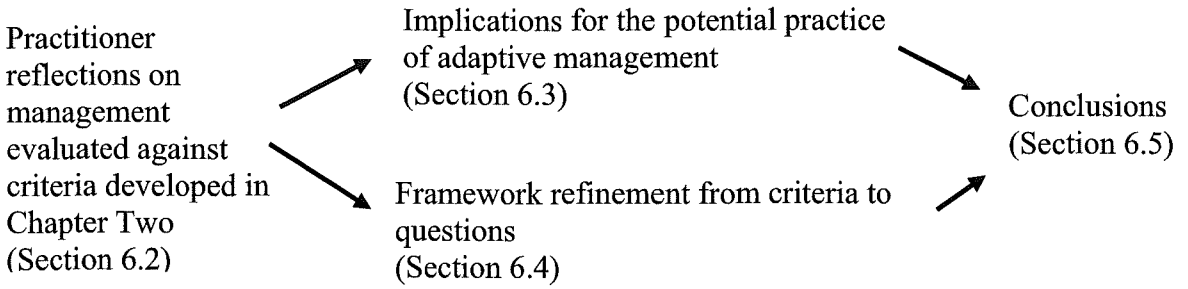

Figure 6.1: Analysis schematic for Chapter Six

6.2 Results

Practitioner reflections of adaptive management and its relationship to current management are presented in this section as they related to criteria groupings they were evaluated against, i.e., over-arching learning process, problem scoping, model building, action, monitoring and evaluation (as outlined in Chapter Five). Seven project groupings are used, as highlighted in Figure 6.2. These include six project-base groups and the co-coordinating and directing group. Where the anonymity of participants is at risk by revealing the projects they are associated with, I have used arbitrary assigned pseudonyms (in this case, birthstones) to identify groups. Where information is publicly available and important for discussion, project names have been used. The co-ordinating and directing group are explicitly identified because their comments do not relate to any particular project. Whilst a summary table of issues pertaining to different groups or pseudonyms may be considered appropriate for ease of presentation of analysis, I have chosen not to present one. If the purpose of the research presented in this chapter had been to develop specific hypotheses about one or other group, then doing so would most certainly have been useful. Given that the unit of analysis in this research cycle was the Mainland Islands as a whole, presenting that type of summary may be somewhat misleading for readers. Instead, I have noted the number of projects in which a particular issue was identified.

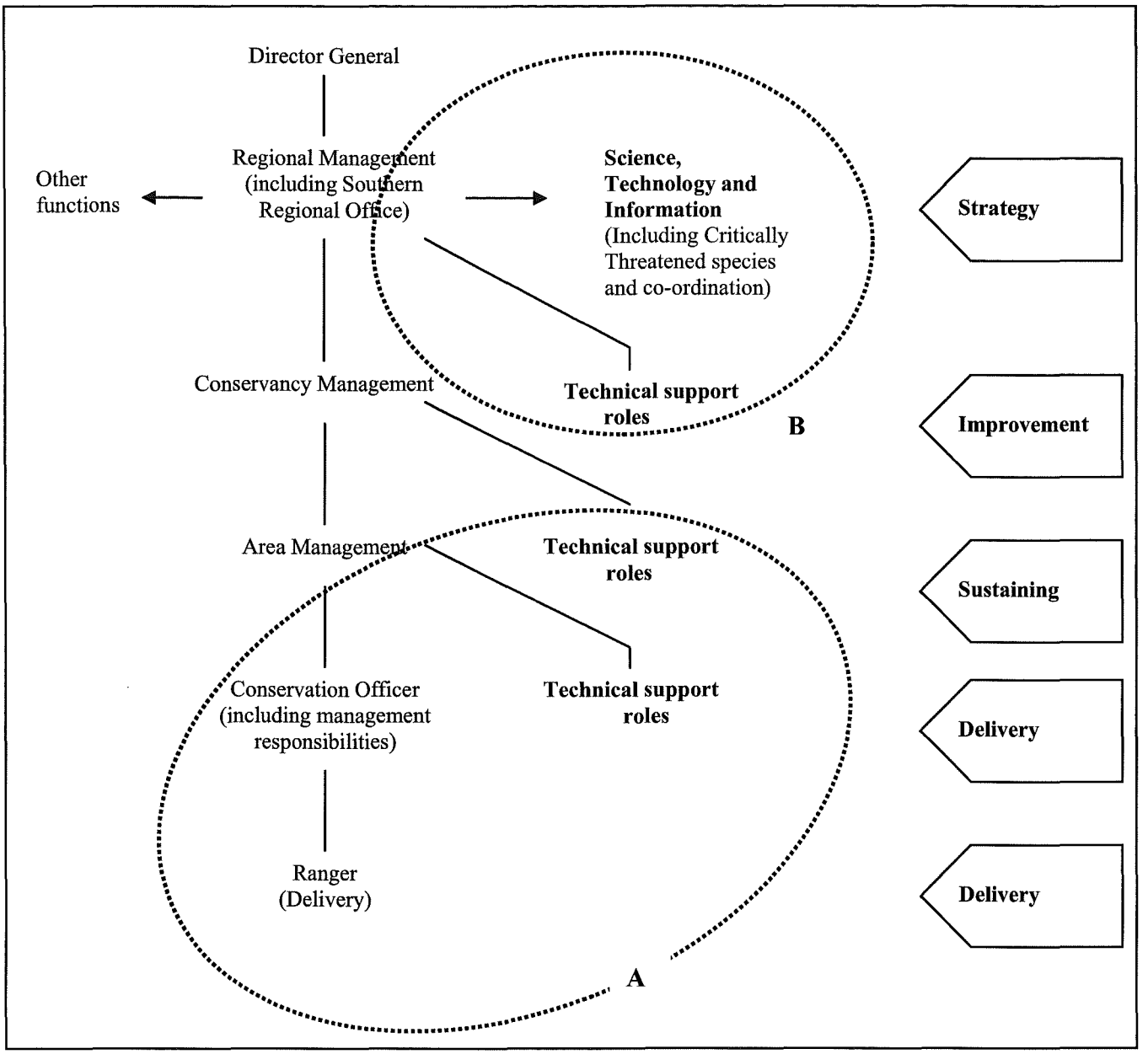

Figure 6.2: Research participant groupings. Research participant roles are indicated by bold font. Details of organisation structure (at the time the research was conducted) and roles discussed in the text are included in parentheses (adapted from http://www.doc.govt.nz). Roles within the line management are included in the shaded rectangle. Shaded arrows on the right indicate hierarchical function. The dotted ellipse labelled "A" and the dotted circle labelled "B" indicate participant groupings for the purposes of this research. The seven groups referred to include 6 "A" groupings (i.e., one pertaining to each project) and one "B" grouping (i.e., pertaining to the projects as a whole).

6.2.1 Learning process

Overall, knowledge about the adaptive management learning process was varied, ranging from individuals who had little knowledge of the term to individuals who had broad and detailed knowledge. The key feature recognised by all participants was that adaptive management equates to a structured learning process, achieved through experimentation with

management. One participant suggested that three forms of adaptive management exist: a simplistic plan-act-monitor, experimental management, and a mixture of experimental management and participatory process that is applied to large areas where project success could be limited without full and formal consideration of stakeholder values in management. The individual noted the first form should be common practice, that the second is expensive, that the third is only necessary in some contexts and that it would probably result in a value compromise for DOC.

Some participants suggested that individual Mainland Island projects were already using adaptive management, yet others suggested alternative approaches such as 'learning by doing', 'experimental management' and 'integrated pest management' were being used. The learning emphasis of adaptive management was further recognised by all of the project groups in their perceived roles of innovative technique development, learning about how to manage on a broader scale (for the good of the whole organisation) and in contributing to knowledge about their particular sites. As one of the participants noted, projects are "...not just taking the recipe, we're trying to make a better cake".

6.2.2 Problem scoping

Half the participants suggested that having holistic goals is important in adaptive management. For three project groups, a holistic approach included a social focus. A number of issues were also raised about the difficulties in having holistic goals. A participant suggested that holistic management was impractical because of the complexity of the systems, and that the term 'ecosystem management' was too "fuzzy" and went against the needs of threatened species work in the projects. Another stated that the projects do not have a holistic ecosystem focus but a narrow species focus. Whilst it is true that threatened species are emphasised, participants suggested that monitored species are indicative of the health of ecosystems.

Perspectives differed when considering whether projects were focussed on producing outcomes, increasing capacity to manage, or both. All project-based groups argued that their emphasis was on developing capacity to manage in an intensive, broad-scale and more holistic way and this was what distinguished them from being simply 'showcase' areas. Most participants from the co-ordinating and directing group suggested, however, that their focus should be purely outcome orientated because they were simply not designed for this purpose nor were they collecting ecological data or integrating it in a way that enabled an increase in

understanding. This difference in perspective on the projects is most probably why the groups Four project groups suggested that there is a lack of support for this function from higher levels in management.

Participating staff recognised the significance of participation and collaboration in managing adaptively. However, their descriptions of 'who' ought to be involved varied. Three types of stakeholders were commonly identified, including internal stakeholders from within DOC, technical stakeholders, e.g., scientists from universities and other institutions external to DOC, and 'others' e.g., community. Involvement of the various stakeholder groups was variable across projects, although involvement of 'other' stakeholders generally occurred "only if they have something to offer". In most cases this stakeholder group was considered recipients of information or as casual volunteer workers and not as contributors to the management decision-making. However, in some projects (groups One and Two), these contributions were viewed as creating long-term support for projects and contributing to their success.

Collaborative processes with internal stakeholders, deemed most important, were considered problematic. Three project groups noted that the projects were over-directed from upper levels of management although two project groups noted the value of increased integration of activities. In all but one group, the need for increased support for and commitment to the processes of networking and communication were identified. Staff indicated a number of barriers to collaboration, including a lack of consideration of others' views by some staff, the personalities and attitudes of other staff, and the general perspective that "lip service" is given to communication and informational issues.

6.2.3 Model building

Very limited knowledge existed about the emphasis of models as part of adaptive management other than in the Co-ordinating and directing group. Four of the project groups suggested that they are system orientated and use a food-web type approach to management. None of the projects have yet utilised qualitative models as per the literature on adaptive management. The Co-ordinating and directing group suggested that the projects lack integration of data that enables a "big picture" and long-term perspective to be gained. Thirteen participants did, however, suggest that the use of either qualitative or quantitative models would be an advantage, two of whom suggested 'shopping' for a generic model and adapting it to the project contexts. It was noted that a significant amount of technical support

and additional resourcing would be required to build models that could be used as part of management planning activities.

6.2.4 Action

Discussion of how planning and implementation of management was conducted was limited, in relation to both adaptive management and in the management of specific projects. Importantly, the need to apply sound principles but to remain flexible was raised in three project groups. Further, all bar one of the groups suggested that managing adaptively required testing anecdotal evidence and assumptions about management, and learning about the best way to achieve objectives. Two project groups argued that decision-making processes and hypotheses needed to be made more transparent. Whilst decision-making in projects was thought to be guided by risk management and economic realities, the use of other decision support methods such as cost-benefit analysis were noted by one participant as being "piss poor in DOC".

The emphasis on experimentation was core to similarities drawn between adaptive management and the Mainland Island projects. These projects are recognised as providing more robust findings than many other DOC projects because of this emphasis. However, there were large differences between project groups and the Co-ordinating and directing group about the quality of experimentation. Issues raised included concern that too few actions are tested, that such tests are not rigorous enough, that management treatments were often not randomly allocated, that use and quality of control sites limits ability to make significant inference, and that experiments are not well designed or developed and few are run for long enough. Whilst these criticisms might be fair from a strictly scientific position, participants also identified that the projects were not primarily chosen for their experimental characteristics. The presence of rare species was also regarded as limiting the ability to take risks and trial management innovations, even though rare species are relatively more common at these sites than this label would suggest.

6.2.5 Monitoring

All participants considered that the monitoring of management actions is a vital component of adaptive management. Monitoring was also considered a strength of the projects, with one participant noting that it accounts for 50-70% of project costs. Recent attempts to determine cost-effectiveness of species protection efforts of DOC (including Mainland Islands) have,

however, identified lack of accurate cost monitoring as an issue (Cullen *et al.* 2005). The DOC monitoring structure allows for both operational monitoring, for example controlled pest populations, and outcome monitoring, for example threatened species deemed to benefit from the operation (DOC 1998c). Rare species were generally thought to be appropriate indicators of management success because of either their sensitivity to management, or because characteristics of their population are functionally important to the health of the system. In every group, at least one participant raised concern about the lack of knowledge on the appropriateness of indicators. One participant argued for greater standardisation in terms of monitoring methods across the projects.

6.2.6 Evaluation

Participants placed importance on systematic evaluation as part of adaptive management, and to current management practice. This included the need for analysis, the integration of results into decision-making processes, the need to be self-critical and to share lessons from management. However, none of the groups provided detail of how management processes are evaluated nor commented on the need to evaluate the appropriateness of goals. A range of opinions existed about the quality of evaluation. Three project suggested improvements in the areas of peer review, integration and use of data, and transparency in evaluation. Additionally, the Co-ordinating and directing group was concerned about the extent to which data are used, the ability to draw inference from it, and the capacity for data analysis at the projects.

Opportunities for communication and lesson sharing between projects were a concern for all bar one of the groups. One participant in particular felt that opportunities created for this purpose were now "hijacked" by more senior levels of management, resulting in less opportunity for communication, co-operation and learning across projects. Interestingly, whilst over half the participants commented on the importance of documenting lessons in order to create a transparent management process, annual project reporting was, at the time of this research, considered haphazard. Reviews suggest annual reports are easily accessible (Saunders 2000b). However, many of the reports are unpublished and one project did not have a five-year plan. Since this research cycle was completed and Saunders (2000b) was published , a great deal more technical information has become publicly available and easy to access.

6.3 Implications for the potential practice of adaptive management

At the time of this assessment, most projects appeared to use adaptive management, albeit in a somewhat limited form. At five of six projects, a five year planning process enables objectives to be set and evaluated at time frames that allow for responses to management actions (at least for bird and invertebrate species) to be measured. The robustness of information used to inform decision making is nonetheless questionable. Some management decisions at some projects may be more informed than others. Lack of management models with which to integrate new learning and a lack of assessment of the appropriateness of goals suggests that these projects are cases where formal and full adoption of adaptive management has not occurred.

Consideration of whether adaptive management is the most appropriate approach for management, and at which level it is most appropriate, is needed. Two possible interpretations for the application of the approach exist: the idea of experimental management linked to a nationally aligned strategic directive, and the idea of case-by-case context-driven applications that emphasise local needs and integrate collaborative and scientific perspectives.
The first interpretation was common among the co-ordinating and directing group in their attention to aspects relating to the quality of planning, experimentation, monitoring, analysis, and information produced for transfer. In addition to calls by participants for standardisation in management and monitoring practice, review recommendations (Saunders 1999, 2000a) relating to a multi-site experiment could be viewed as an attempt to amend these weaknesses. In this sense, adaptive management has been interpreted as 'research by management', and is akin to the experimental emphasis on adaptive management outlined in Chapter Two.

Opportunities for implementing adaptive management in this way are however problematic given the differences in ecological and management contexts of the projects (highlighted in Chapter 4.4). Importantly, this interpretation would require greater co-ordination than existed at the time of this research. It is also likely to be somewhat problematic given that participants explicitly credited problems associated with coordination and communication to the changes in management alignment of projects from nationally-based funding to funding based on a competitive model within the management line structure. A rationalisation of project functions would also be expected due to the inherent differences in experimental value. Hence, this interpretation of adaptive management may result in an experimental focus for some projects, a showcase function for others, and a purely performance oriented focus for others dependent on their perceived value.

Clearly, there are some cases where specific emphases are appropriate. For example, the isolation of Hurunui Mainland Island (HMI) and the critical nature of its threatened species populations (HMI contains the only known population of orange-fronted parakeet) would suggest it is in urgent need of a performance oriented function, and may be the only place where research relevant to species can be conducted. Other projects may be more suited to a mixed emphasis. Northern Te Urewera Ecosystem Restoration Project (NTUERP), for example, is ecologically important both within its Conservancy and nationally, requires community buy-in because of the extent of its border and the cultural significance of the area, has provided nationally significant biodiversity outcomes, and provides opportunity for advances in management techniques because of its size.

A nationally aligned multi-site experiment risks jeopardising locally important issues and limits opportunities for community buy-in that are strongly valued at a number of the projects. For example, the transfer of Kokako between NTUERP and Boundary Stream Mainland Island (BSMI), the community control of wasps and stoats in border areas that reduce re-invasion into Rotoiti Nature Recover Project (RNRP), and the control of rabbits in surrounding farmland in order to reduce available food for predators at Trounson Kauri Park (TKP), are some examples where management success has been conditional on the support of local communities and land owners. These initiatives clearly demonstrate the opportunities provided in considering management opportunities from a context-driven perspective, i.e., 'management by research' rather than 'research by management'. Further, there is opportunity for both synergy and innovation in having multiple emphases within a particular site, including the cost efficiencies of tendering to collaboration, biodiversity protection, and capacity development within a single site and the increased profile that each activity brings to an individual site.

Importantly, Mainland Islands are considered to be sites where 'learning begins' (DOC 2005b). Examples of innovations from Mainland Islands include a new trap design that was initiated at one project, developed further by another, with design improvements implemented and further developed at the original project. Another example is of the use of dead rats as a lure in mustelid traps which is directly credited with influencing the development of a new artificial stoat lure at a time when the national standard was to use hen eggs (pers. comm., A Byrom, 2004). One project also pioneered the use of predator dogs to search for mustelid dens, a technique which is now in national use (DOC 2002).

If support for adaptive management is to be provided on a case-by-case basis, many of the science-oriented comments made by participants, especially the Co-ordinating and directing group, require attention. These comments include the need to make assumptions about system behaviour, reasons for technique choice, and to make hypotheses being tested by management and the associated levels of scientific rigour explicit. Thus, management processes will become more transparent allowing for increased ability to integrate data, for the appropriateness of assumptions and validity of analyses to be more easily assessed and for effective learning to occur. A lack of in-use ecological models makes it difficult to assess which uncertainties are central to improved management at the sites and how the integration of current learning has contributed to their refinement. A context focus for management that values innovation does not preclude a more co-ordinated approach to experimentation of some common elements across sites, for example toxin trials and species translocation, nor does it preclude capacity developments in areas of national interest where they also offer opportunity for enhancing management outcomes at the local level.

The capacity to move in the direction of context-driven adaptive management is also dependent on addressing issues associated with organisational culture. An apparent risk-evasive culture hinders the ability to utilise management experiments. In some cases, this is justified given the critical nature of threatened species at some sites. However, at other sites endangered species are not considered locally rare. As such, learning remains incremental. Support for adaptive management in these projects will no doubt require demonstration of the capacity development function. Saunders (2000b) provides some indication of information transfer and uptake at other projects. However, this feature is not currently a measured performance outcome. In order for effective transfer of learning to occur, organisational issues surrounding communication, networking, and openness to peer review must also be further explored and addressed.

Several staff that participated in the research have since spoken about their reflections on the report of the research findings including how it influenced a change in their perspective on the importance of context (especially social context) in considering opportunities for adaptive management, and the change in management culture that needs to occur if management is to be more adaptive. Importantly, one highlighted that "there's not much you could do about the problem of what Mainland Islands are for", suggesting that a lack of clarity on collective project purpose contributed to descriptions that the projects are "poorly conceived, lacking in

focus and substance...". A participant also noted that projects may have a "neighbourhood consideration", and are hence dependent on achieving biodiversity outcomes that contribute to both Conservancy and national level commitments. Whilst the adherence to national-level biodiversity policy commitments is understandable, individuals involved at the project level continue to argue that their ability to do so is limited by progress on recommendations from the reviews (i.e., Saunders 1999, 2000a, 2000b) which one participant described as having been "stonewalled". This description highlights a tension between interpretation of Mainland Island purposes and project goals in the reviews, and actions to enable the fulfilment of them elaborated on more fully in the conclusions section of this chapter.

While Mainland Islands may claim that they are learning orientated and that the value of that learning ought to be recognised by DOC, information transfer outcomes are commonly reported by means of listing reports produced, many of which are not easily accessible to those outside of DOC. Additional indicators include details of research completed in conjunction with the projects, media releases, the numbers of staff exchanges and visits, walkway and interpretation upgrades, the number of volunteer host days, and the numbers of people in attendance at school and community talks. Whilst these indicators demonstrate an effort to transfer information, they do not provide any indication of information about end-users or uptake levels. Hence, whilst the argument about which form of adaptive management is most appropriate for these cases is valid and timely, the capacity to demonstrate the value of these projects and the learning that is occurring was considered to be more important in sustaining their survival in the short-term. This emergent research direction is progressed in Chapter Eight.

6.4 A participatory evaluation framework for adaptive management

In analysing responses for this phase of framework development, I found that the level of detail encapsulated in the high number of criteria was difficult to evaluate against. On a more positive note, several participants commented that reflecting on the practice of adaptive management was a very useful exercise. Staff also commented that the exercise made them think, was a positively challenging experience, and provided opportunity for learning, for getting their voice heard and for sharing their views. This supported my desire to develop the framework in a way that could be used in a more participatory and interactive way, thereby ensuring greater benefit from it.

The framework, in question format, was presented at the 3rd International Wildlife Management Congress (Jacobson *et al.* 2003a). This process enabled staff from the projects involved (many of whom attended), and other adaptive management practitioners to give informal feedback, re-enforcing that this was a useful tool. The usefulness of the exercise was also reinforced during a meeting at the conference with one of theDresearch participants who commented that the research was not just about showing that the department was doing adaptive management, but that it was about cultural change in the organisation and the way they managed. The framework and justification for the questions within it is presented in the following section.

6.4.1 Criteria inclusion

As discussed in Chapter Two, formative evaluation conducted within a participatory context requires the use of questions that enables the identification of relative strengths and weaknesses of management in areas central to the aspect being evaluated. My own reflection on the exercise detailed in this chapter enabled criteria to be adapted into a question format. Central to this process, as described in Chapter Three, was avoiding duplication of ideas, addressing essential ideas (and discarding peripheral ones), consideration of both social and experimental aspects of adaptive management within each step (as is argued for in Chapter Five), and relevance (and language) from within the New Zealand context. Avoiding duplication of ideas was of crucial concern at this stage of framework development. Table 6.1 provides a summary of the development from criteria to questions.

Table 6.1: Summary of changes in framework development from criteria to questions

Step	Number of criteria prior to Mainland Island evaluation	Presented as questions
Learning process	12	0 (see assessment below)
Problem scoping	26	8
Model building	9	5
Action	22	10
Monitoring	5	4
Evaluation	8	10 (includes criteria from learning process)
Total	82	37

During the process of development, some criteria were simply reframed as questions. Others were moved into more appropriate sections. When using the framework in the evaluation presented in this chapter, I realised that there was substantial duplication of ideas, and that the likely depth of reflection did not justify the transformation of all criteria into questions. Formation of many questions hence represented the integration of several criteria. The practice of adaptive management in the New Zealand context also appears to be less policy-

oriented than elsewhere, leading to review of criteria incorporating the word 'policy'. The final questions, and their development from criteria presented in Chapter Two are now discussed as they relate to each step of the process.

Over-arching learning process

I chose to structure the revised framework around the key steps of adaptive management. Criteria relating to the learning process were not completely dismissed. Instead, they were incorporated in a number of other ways. Firstly, questions relating to the world-views were intended to be included in the introduction to the evaluation exercise, where uncertainties addressed by management, and thus the need for adaptive management could be clarified. Key questions relating to learning from failures, assessing assumptions, assessing the relevance of goals and supporting a formalised learning process (criteria 1, 2, 4 and 6) were included in the evaluation section. Criterion nine (recognise the effect of value judgement on methodological choice) was included in the action step.

In addition to the inclusion of criteria in a more generic discussion of the evaluation process, this initial discussion was also considered an appropriate opportunity to signal my intent to ask probing questions such as 'why?' and 'how do you know that?' to elicit reflection. Further, I intended to ask participants to grade their response to each question using a traffic light system adapted from Kilvington and Allen (2001); a green dot for aspects that are considered to be done well, a yellow dot for aspects considered to be less well done and potentially limiting management success, a red dot for aspects considered as limiting management success, and a black dot to represent aspects considered irrelevant or unimportant. These features address means of identifying relative strengths and weaknesses of management, respectively.

Step One: Problem Scoping

When asked to describe what they thought adaptive management was and the ways in which it was currently being used in Mainland Island projects, participants commonly began by discussing the goals of their project. Doing so appeared to provide a point of reference and ensure focus for the proceeding discussion. Questions relating to management goals were moved to the fore of the framework in a response to this.

One of the criteria from this section (criterion 29 – aim for long-term learning) was included in the evaluation section. Two criteria were considered more peripheral; the need for a holistic focus (criterion 31), and managing for a performance range (criterion 33) and were hence excluded. Fifteen criteria relating to collaboration were incorporated into just three questions. Whilst this may seem overly reductionistic, I did so to avoid an over-emphasis on collaboration, given that it is also attended to by the incorporation of socially oriented questions specific to subsequent process steps. Two criteria are assumed to be addressed by these questions: criterion 16 (decision making processes agreed to) and criterion 17 (agreed process of management adjustment). Questions relating to the problem scoping step, including sub categories of goal setting and collaboration, and the respective criteria they are derived from are outlined in Table 6.2. The criteria numbers referred to are those from Chapter Two.

Table 6.2: Evaluation questions addressing Step 1: Problem scoping

Evaluation question	Contributing criteria
Goal setting (i) Do you have a shared vision and a set of goals to match?	30. Balances vision and goals 28. Involves stakeholders 22. Develops a shared understanding of the management problem
(ii) Are management boundaries clearly defined?	34. Clearly defined management boundaries
(iii) Do goals consider ecological and social aspects of the management context?	35. Include social objectives
(iv) Are goals aimed at managing uncertainty?	33. Develop understanding about cyclical processes 36. A desire to build resilience 37. Focus on improving capacity 38. Goals to increase understanding
Collaboration	
(i) Have relevant stakeholders been identified and provision made to involve them?	13. Includes a range of affected stakeholders 14. Actively involves stakeholder 15. A structured and formalised process 18. A structured collaboration process 19. Addresses conflict 24. Promotes co-operation
(ii) Have communication networks been identified and a process for ongoing communication been established?	20. Fosters communication 21. Supports interactions that build trust
(iii) Do you have adequate capacity for your project (i.e., people, skills, resources, institutional support?)	25. Explores informational needs 26. Identifies a range of information sources 27. Addresses problems in an interdisciplinary way 23. Facilitation skills utilised

Step Two: Model building

Nine criteria relating to model building were reduced to five questions (Table 6.3). Some of the criteria related to very specific detail about the modelling process and were therefore

considered inherent in more generic questions. Importantly, I had to address an initial assumption in the first framework version that a model of the system had actually been developed. Criterion 42 (key indicator species and processes) was incorporated within the monitoring section.

Table 6.3: Evaluation questions addressing Step 2: Model building

Evaluation question	Contributing criteria
(i) Has a model of the system been developed?	43. Avoids over-parameterisation 44. Useful for identifying leverage points 45. Development process used as a means of structuring debate
(ii) Have relevant sources of knowledge been identified and drawn together to use in the model?	26. Identifies a range of information sources 27. Addresses problems in an interdisciplinary way
(iii) Have uncertainties in knowledge and assumptions in the model been acknowledged?	39. Assumptions made explicit 40. Uncertainties in model acknowledged 41. Knowledge gaps are identifiable
(iv) Are interactions between temporal scales and spatial scales recognised (e.g., lag effects or invasion risk)?	46. Address issues of scale – both temporal and spatial
(v) Is the model translatable for stakeholders?	47. Must be translatable for policy makers (policy removed because of lack of fit with NZ context of practice)

Step Three: Action

Step three, 'action' was split into two parts, planning and science considerations, in order to expose and give prominence to the science emphasis of adaptive management. Several central concepts provided opportunity to merge criteria into more generic questions as per the model building step. Two more vague criteria relevant to planning (criterion 54 transient solutions are accepted and criterion 50, decisions are not rigid and inflexible) were excluded.

Five questions relating to science consideration were included in the re-developed framework. A central question at this stage was question three, 'has focus been given to the biological significance of findings?' This question emphasises the use of science to improve knowledge particular to the management situation rather than emphasising wide generalisability of it. In particular, the degree of certainty required by managers may be less that than required to provide statistical significance. The use of science language (i.e., type two error) was removed in order that the framework had wider audience appeal. Criterion 64 (policy choice is recognised as experimental) was excluded, given the lack of emphasis on policy within the New Zealand conservation management context. Table 6.4 provides detail of the development of this part of the framework.

Table 6.4: Evaluation questions addressing Step 3: Action

Evaluation question	Contributing criteria
Planning (i) Have management options been identified and stated as hypotheses about system behaviour?	48. Management options and or policies formulated as testable hypotheses about system behaviour 49. Assumptions supporting hypotheses are explicit 59. Uncertainty is recognised
(ii) Have predictions been developed for each option?	Added as it ensures coherence with evaluation section and enables learning to occur
(iii) Have stakeholders been included in decision making?	55. Stakeholders are involved in the process
(iv) Have risks and trade-offs been made explicit?	51. Trade-offs are documented 52. Risks are assessed 53. Cost-benefit analysis is considered 57. Actions robust to uncertainties are favoured 60. Irreversible risk is avoided 61. Risk taking is guided by values 62. Risks are justified if they strengthen understanding.
(v) Have ecological imperatives been considered equally with economic and social imperatives?	56. The process is driven by ecological imperatives 58. Policy imperatives are given equal parity to economic ones
Science considerations (i) Have management actions been designed as experiments and are they recognised as such?	63. Management actions are designed and implemented as experiments
(ii) Are effects of value judgement on method choice recognised?	9. Recognises the effect of value judgements on methodological choice
(iii) Has focus been given to the biological significance of findings?	65. Getting the right science before getting the science right 66. Focus given to minimising type two error rate 67. Biological significance emphasised
(iv) Have compromise and constraint been accepted?	68. Compromise and constraint accepted
(v) Have time lags been considered?	69. Response to time-lags considered

Step Four: Monitoring

Four questions relating to monitoring were included in framework revisions (Table 6.5). One of these was derived from criteria relating to the learning process category (Criterion 49). Others involved a simple re-framing of criteria as questions, as well as merger of criteria relating to the use of indicators.

Table 6.5: Evaluation questions addressing step 4: Monitoring

Evaluation question	Contributing criteria
(i) Is the monitoring conducted systematically and in relation to objectives?	70. Monitoring is planned for and conducted in a systematic way
(ii) Are short and long term responses monitored?	71. Short and long term responses are measured
(iii) Are appropriate indicators used?	42. Key indicator species and processes identified 72. Indicators are used 73. No more than 10 indicators/measures
(iv) Have stakeholders been given an opportunity to be involved?	74. Community is involved

Step Five: Evaluation

At various stages during the progress of this thesis research I reconsidered the title of step five. I ultimately decided to use the word evaluation rather than feedback or assessment as it fitted the language used by research participants to describe this step. The questions in this step represent a combination of criteria from the learning, problem scoping and evaluation categories. Ten relevant questions are presented in Table 6.6.

Table 6.6: Evaluation questions addressing Step 5: Evaluation

Evaluation question	Contributing criteria
(i) Is evaluation conducted systematically and in relation to goals?	75. Analysis is conducted in relation to goals and objectives
(ii) Are lessons documented?	76. Lessons are documented
(iii) Is the management process transparent?	77. The process is transparent
(iv) Is the process iterative?	29. Aim for long-term learning
(v) Is the evaluation completed in relation to the timing of ecological events?	80. Timing of evaluation matches the scale of ecological processes
(vi) Are failures and unexpected results treated as learning exercises?	6. Failure treated as learning experience
(vii) Are assumptions and uncertainties evaluated?	4. Formalised double loop learning process
(viii) Is the appropriateness of goals evaluated?	2. Assessment of the wrong goal
(ix) Are management and learning processes evaluated?	78. The success of management processes are assessed 82. Different approaches to assessment can be trialled
(x) Are practitioners and organisations self-critical?	81. Practitioners are self-critical

6.5 Concluding comments

In this chapter, I have avoided normatively defining adaptive management and evaluating each project against it. The evaluation presented in this chapter has highlighted that projects involved were associated with a lack of common or shared interpretation of adaptive

management. Whilst some form of an adaptive management process is currently being used in these projects, a formalised and explicit adaptive management process including the use of models is not. Reflection is limited to a simple linking of evaluation and planning processes.

Importantly, issues related to the appropriateness of different styles of adaptive management and the way in which each could be applied have been raised. Whilst the style preferred by technical support is for large-scale, spatially replicated experimentation, i.e., 'research by management', issues concerning experimental attributes of sites and an apparent inability for strategic co-ordination across the sites suggests that a context-specific style , i.e., 'management by research', may be more appropriate. If adaptive management is to be more formally applied in the latter style, issues regarding the scientific rigour of developments must still be addressed. This will require acknowledgement from within the line management structure that the true benefits of learning where uncertainty exists requires more than a simple plan-act-reflect cycle designed to link planning and outcomes. In addition, if the projects are to continue to justify their expense on the basis that learning from them is being used to grow the capacity of DOC for large-scale restoration on mainland New Zealand, then this ought to be demonstrable.

In planning for a third research cycle, I presented my research findings to the groups and noted my interest in ongoing research, in particular to work with the projects to test the framework developments. However, my inability to get buy-in to do so provides a point of departure for the thesis. A more immediate concern for ongoing support of management identified by staff aligned with individual projects is the ability to demonstrate the value of learning that occurs. In Chapter Eight, I work with individual Mainland Island projects by instigating a joint inquiry using an adaptive learning process that focuses on a smaller and more pertinent aspect of their management (i.e., information extension). However, I did not want to dismiss the opportunity to continue to develop the framework presented in this chapter.

The evaluation presented has demonstrated a need for in-depth reflection of adaptive management, particularly in relation to processes used in management that received little attention from participants in this evaluation. Importantly, the framework developed includes questions that support reflection on these aspects. The framework may also play an important role in structuring debate on the appropriate form of application of adaptive management and bring management context to the fore when doing so. The next steps in framework

development are to test it with practitioners. In Chapter Seven, I return to a wider group of practitioners from within the New Zealand conservation setting to explore the potential value of the revised framework.

Chapter Seven: Using formative evaluation to build reflection on adaptive management: a cross-case analysis

7.1 Introduction

In previous chapters, I developed the argument that the practice of adaptive management is polarised in focus. Chapter Six provides a detailed example of the implications of different interpretations of adaptive management for more formal (and full) adoption of the approach. Reflections on adaptive management were used to transform criteria for the practice of adaptive management outlined in Chapter Two into a series of questions designed as a more structured way to support reflection on the practice of adaptive management. In this chapter, I present the third and final step in the development of a framework designed to be used as part of a formative, participatory evaluation exercise. The key purpose of this cycle of research was to assess whether the framework can help practitioners reflect on their use of adaptive management. Through a description of practitioners' reflections on the evaluation exercise, I illustrate that the framework is a useful tool in building reflection on adaptive management, including on aspects of adaptive management that are less central to the professional paradigm of practitioners. I end the chapter by presenting the final change made to the framework in light of these reflections.

As outlined in Chapter Three, action research involves a process whereby research with a case(s) provides data and analysis in relation to both the case(s) involved, and the process used. To this end, testing of the framework presented in this chapter included five practitioners involved in established projects (i.e., running for over one year) explicitly practicing adaptive management. Whilst I have avoided naming which projects were involved in an attempt to preserve anonymity, Chapter 4.3 does provide a comparison of different adaptive management projects from within the New Zealand context from which participants were selected. Conclusions about the practice of adaptive management in Aotearoa-New Zealand are made possible by comparing practitioner ratings of different questions, i.e., the aspect is done well, might be limiting practice, is definitely limiting practice, or is not relevant within a given context. Participant reflections on the evaluation process itself, including the content of the framework, enable assessment of the benefits of participatory evaluation on adaptive management, and are presented in the second part of this chapter. Additional information on methods is provided in Chapter Three, while Figure 7.1 provides a summary of the analytic process used.

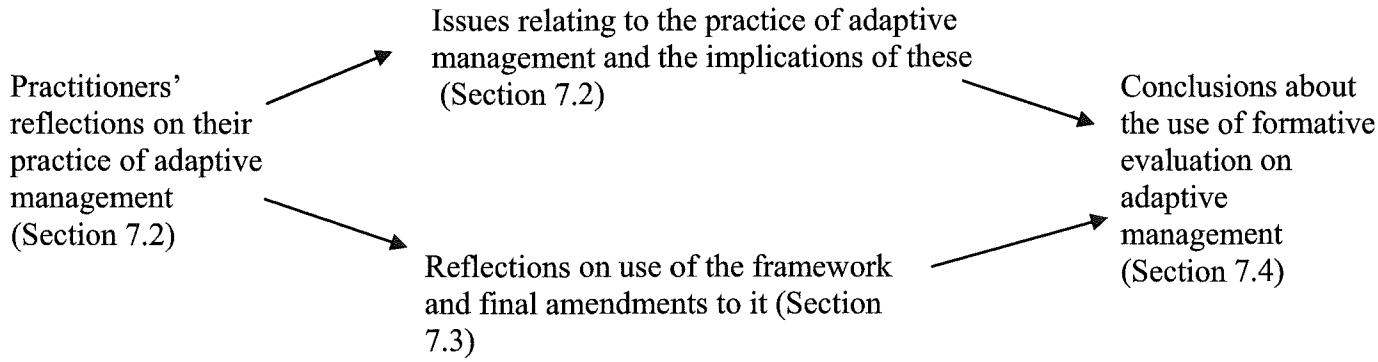

Figure 7.1: Analysis schematic for Chapter Seven

7.2 Case results

In this section, I explore the reflections that arose from the evaluations (in relation to each step of the adaptive management process) and the implications of them. Lastly, I present a summary of factors identified as either a contributor to the success of the project or a limiting factor as relates to each step of the adaptive management process, and the implications of this for the practice of adaptive management in the New Zealand conservation context. As is noted in Chapter Three, quotes are used to illustrate key points made by participants during the evaluation exercises. Where differences in perspective were evident, they are either presented or commented on.

7.2.1 Problem scoping

Participants placed a strong emphasis on research that is relevant to management. In this sense, all of the projects were issues driven, asking 'what can we achieve' or 'how do we achieve' questions, as opposed to focusing on 'what is the best management option for this particular site'. One participant shared their perspective on this, highlighting the importance of simplicity to ensure relevance to managers, as is evident in the following excerpt:

> As I've gotten older, I think there's a real chasm between ecological theory and management. If you look at what's holding up managers...they're profoundly basic things.

Another commonality between the projects participants were associated with is that they involve multiple study sites, linked in some way, often as a means of providing spatial replication in experimental design (four of five projects). This leads to a two-tier management system, where goals may be different for individual projects, but where there is "a shared vision of why they want to work together". Reflections from one participant indicated that having the project manager outside of DOC was seen as beneficial. Another participant

indicated that there are problems irrespective of the agency alignment of the project manager. Co-ordination within DOC was viewed as important to ensure commitment to the projects. For example, one participant responded to a probing question of what things they would do differently by stating that "one would be permanent, dedicated staff throughout the organisation, in a co-ordinating role and that can really only be done in the organisation because we don't get to sit in on the decision making process". Another described the commitment and dedication of staff as "another lucky thing", and the network they had established as "the perfect vehicle for maintaining formal communication".

Because of my argument that managers need to reflect on both social and ecological aspects of adaptive management, questions were included in the framework about the consideration of both ecological and social aspects of the management context, and about equal consideration of ecological, social and economic imperatives in decision making. Participants commented on the fact that economic imperatives seemed to be more important than social imperatives, as is evidenced in the following two excerpts:

> Excerpt 1:
> Well, we know that because that's the Department's imperative, to have priority for ecological matters, but, um, I would say that when we were doing the trade-off analysis it was very much ecological vs. economic.
>
> Excerpt 2:
> They have no idea what the ecological imperatives are so that's just guesswork...what really has driven it is... a combination of all three...the ecological imperatives are what managers were interested in but its always mucked around with by their own economics...The question is, has the economic imperative over-ruled managers at all levels in the long-term?

They commented on the capacity and capacity needs of projects. One participant commented that the longevity of the project was about its social and economic sustainability. Another highlighted the significance of having adequate social capacity, but noted that this was considered secondary to science training in the project they were aligned with, as is evident in the following two excerpts from their evaluation:

> Excerpt 1:
> A Do you have adequate capacity for your project?
> B I think we had the right science people... but I'm not sure that those science and ecological management people were right for the communication social side of things. In fact, I'm almost certain that that wasn't the case.
> A It's a different type of people that need to be involved than what you first thought?
> B They have to have a person who you know is equipped or you have to have 2 different people... and that's not always easy, it takes extra costs...
>
> Excerpt 2:
> B ...ecological scientists, you know...
> A Ecological scientists don't do that?
> B I think they find it harder to do. I'm talking about the social bit.

A So if you had social scientists you think that would have made it a different kind of project?
B Yeah, I think it would have.

These comments indicate that the projects heralding participants for these evaluations have strong science support. As a result, an emphasis on quantitative models can be expected.

7.2.2 Model building

All projects associated with participants involved in evaluations included models, of which four of the five were quantitative models. Participants' reflections indicate the significance of ensuring that models of system component interactions, both temporal and spatial, are translatable for stakeholders. The following excerpt exemplifies this point:

> One of the things that I felt was a bit weak was what should have been done from day one was the distribution of...and how they were increasing and decreasing over time and that would have shown the local residents [the effects]...it just wasn't as clear as it could have been...we knew full well this thing... but I'm not so sure they were communicated as well as they could have been.

In the projects using quantitative models (three), model development came as an output of the adaptive management process, due to limitations in existing knowledge affecting the ability to construct an *a-priori* model. Institutional issues associated with subsequent use of model outputs were raised by one participant, as is evidenced in the following comment:

> Yeah, I think in a big complicated organisation like DOC you need to do this whole process of adaptive management in a decision support system... the other issue is with information management officers... you've got a whole great swaff of them at head office...one of the things that fell out of our work [was the DSS]...DOC's forbidden to use that because it's never been approved...what happens is that it comes off the backs of trucks and they use it.

In the normal course of adaptive management, models are used as part of decision-making (see Chapter Two for details of this). Model development after management experimentation may have precluded this from occurring in these projects, and it is likely to have contributed to the lack of further incorporation of models in management decision-making.

7.2.3 Action

A feature perceived as crucial to the success of adaptive management projects by all of the participants was the commitment required by those involved in such initiatives. As noted by one participant, good relationships with ground-level managers are crucial. However, in some instances, they were considered problematic, as is evident in the following comment:

> A new monitoring officer who started to panic because they were lent on from up high and told 'no, you won't break the protocol'. It wasn't us it was the other managers...but they're peeved because some of the other managers who did the leaning on didn't actually stick to their own protocol.

During the exercises, several comments were made about the differences between the perspectives of scientists and managers, and the implications of this for adaptive management. The following three excerpts, made by different participants, demonstrate that managers are often considered to misunderstand the science requirements of adaptive management:

> Excerpt 1
> I have an issue with managers thinking that they're doing AM...it can be used for managers to justify almost anything....That 'well, we tried it, and it didn't work, now we're trying something else'...that sort of manager's disease.
>
> Excerpt 2
> It was never an assumption, it was a hypothesis... the managers had it rammed down their throats that these things were just hypotheses which is the essence of AM...that's the difference between managers and researchers, managers assume they know or 'at least that's a good bet so let's say it's true'...the whole essence of AM is regarding that uncertainty as uncertainty.
>
> Excerpt 3
> We had great difficulty to get them to do non-treatment because of the extra cost. DOC doesn't by-and-large do non-treatment, so all of their inferences from management are pretty low.

Two participants also commented on the need to make ecological sacrifices in order to increase the effectiveness of management – especially where the results of the management experiments would be useful elsewhere, as is evident in the following excerpts:

> Excerpt 1
> It's sort of like a Tragedy of the Commons to do this. The information is useful for the whole range of different projects.
>
> Excerpt 2
> We wanted it to fail...then you get the business over with...in the spirit of what was going on, it was a necessary short-term gain in relation to the long-term goal.

Importantly, all participants were able to identify (using examples) that adaptive management meant accepting compromise and constraint in terms of experimental virtues. Other issues identified as barriers to sustaining practice included staff turn-over (commented on by one participant), financial support and the financial systems of DOC (commented on by four participants).

7.2.4 Monitoring

A key feature in the practice of adaptive management identified by participants as having the potential to either contribute to project success or to limit it was standardisation in monitoring. The following comment exemplifies this perspective:

> We assumed that managing pests would increase [the goal]...your hypothesis should spit out what you monitor...and these were really good decisions...this is the guts of why the programme worked... there's nothing flash about it, it's profoundly strong logic...what was immutable was that people monitor residual abundance... and that it be done by absolutely non-negotiably identified methods...and those were key success issues.

In other cases, knowing what to monitor was an issue. Two participants commented that knowing what to monitor should be obvious, and that "the wording should go 'what criteria did you use to select indicators?'" A third participant indicated that issues associated with funding, staff commitment and ecological knowledge affected monitoring, as is evident in the following excerpt:

> They've contracted resources once and never gone back so that failed...we didn't measure the resource cue things very well...the ones that failed were these ...ones where they panicked once it got up a bit and the ...[management treatment]... where they went in once and ran out of money and didn't do anything else.
>
> The conservancy didn't always have the funding. There were a few places where it failed. There was one place where they didn't do any monitoring at all and there was one where they did... but it was on species they were interested in....In the start we have a rationale and in retrospect they weren't as responsive... so we've learnt a lesson there.
>
> All these problems about what to monitor...that's really unresolved.

In addition to identifying issues with respect to the selection of appropriate indicators to monitor, practitioners also identified issues with the use of monitoring information in evaluation.

7.2.5 Evaluation

A key issue for participants associated with two of three projects nearing the end of a management cycle was the ability to iterate. In both of these cases, the project manager was outside of the organisation, but utilising ongoing management as treatments. Several issues were identified as causes of this: resources, the societal pressures on DOC, over-success, and changes in organisational emphasis, as is demonstrated in the excerpts below. No insights were provided by the third as to factors that enabled iteration.

> Excerpt 1 - resources:
> Managers should be sitting down about now and be saying 'what have we done, we'd need to run another iteration ...the key things is it costs an awful lot more than people are prepared to spend to answer substantial questions.
>
> Excerpt 2 – societal pressures:
> There were dedicated researchers and managers and continuity of involvement...and this was another lucky thing, we did the whole thing before that ultra-precious kakapo thing where every animal is national news.

Excerpt 3 – over-success:

A: The success of the project is the reason it's been triaged?

B: Absolutely. ...You can do that for a while but it loses its way...then the uncertainty becomes substantial.

Excerpt 4 – changes in organisational emphasis:

B: What DOC needs to do is, when they get through all of these reports, is look at the biological lessons...and, if they should formally continue this project...

A: And so that's something you've planned to do with those managers?

B: That depends on {comment omitted} and they'll say 'no, we've moved on, we don't do that anymore'.

All of the participants at this project stage identified unexpected outcomes from their project experiences. Even the participants who identified failures and outcomes that affected the viability of their projects were able to identify positive outcomes and contributions that their projects had resulted in, as evidenced in the transcript below:

A So you're not sure they've learnt any lessons?

B Well, yeah, principles... are very well summed up...

A So are {comment omitted}people picking up on it?

B No...

A So in terms of learning with DOC then, I'm almost hearing a red?

B No, I think some people have learnt...that's been, the principle, reasonably influential.

All completed projects also questioned whether full advantage was drawn from the lessons of the projects. Indicative reasons for this are primarily directed at the value of science and science information. Pertinent comments from three respondents are included below:

> I don't think they've learnt as much as they could have. I think some managers have and some haven't, and I say that because I think there are some managers who take the gut reaction but I think it needs to be complemented by something else.

> I think that the Department, had it been focussed genuinely on biodiversity outcomes, would have been relishing the whole unfolding of the programme, but it's not the way it seemed.

> The other issue is with information management officers...you've got a whole great swaff of them at head office...one of the things that fell out of our work {comment omitted}...DOC's forbidden to use that because it's never been approved.

It is useful to consider reflections on this step of the adaptive management process alongside those from other steps. Doing so enables implications to be drawn about the current practice of adaptive management in New Zealand.

7.2.6 Summary and implications

There were a number of factors identified as success and limiting factors to each step of the adaptive management process. These are presented in the summary table 7.1. Matches between success and limiting factors in responses are shown where appropriate. Importantly,

the participant who identified significant success at their project identified that many of the success factors were more luck than wise planning.

Table 7.1: Factors promoting and limiting success in adaptive management identified from participant interviews

Adaptive management step	Factor promoting success		Potential limiting factor
1. Problem scoping	Balance between imperatives	...	Imbalance between imperatives
	Effective co-ordination structure	...	Lack of dedicated co-ordination
	Resourced communication structure		
	Flexibility to include additional stakeholders		
	Effective interpersonal skills	...	People with imbalanced skill sets
		...	Inexperience with adaptive management
2. Model development	Not letting model subsume project	...	Model uptake and use
	A shared and simple-to-translate model		
3. Action	Strong science support	...	Lack of commitment to scientific proviso
	Committed and dedicated staff	...	High rates of staff turn-over / lack of institutional memory
	Focus on biological significance		
	Recognising uncertainty as such		
	Organisation and public who are prepared to accept short-term loss for learning potential		
4. Monitoring	Standardisation of monitoring	...	Lack of commitment to monitoring
			Difficulty of knowing long-term responses of plants
5. Evaluation	Ability to iterate	...	Inability to iterate
			Limited utilisation of learning from project
			Lack of skills to evaluate social uncertainties

The use of different sites as experimental replicates is akin to the model of active adaptive management described by Possigham (2000). Whilst it is tempting to suggest from these reflections that one of the implications of this model of adaptive management is that greater organisational capacity is required, and this may be so, organisational co-ordination and commitment are also identified as necessary in other forms (e.g., Holling *et al.* 1995) and therefore need to be attended to by all practitioners of adaptive management.

Issues raised regarding the balancing of different imperatives are also issues that face all project managers given the different limitations of working within either a singular organisation's resource limitations, or within the boundaries placed by any multi-stakeholder institution. What is apparent from the reflections provided is that the traditionally emphasised skill-set of ecologists is not sufficient for the purposes of successful adaptive management. As has been argued in the literature (e.g., Allen 2001b, McLain and Lee 1996, Lee 1993),

adaptive management requires interpersonal skills including effective communication and team-work in addition to a more theoretical and applied understanding of social engagement processes.

The literature describing model development in adaptive management clearly indicates that the formation of models should occur prior to management experimentation (e.g., Johnson and Williams 1999, Schreiber *et al.* 2004). Only two of the projects hailing participants in these evaluations had quantitative models, and these were produced after experimentation (note that a further two were not yet at the modelling stage). A potential reason for this is a lack of appropriate data to form *a-priori* models. However, these comments indicate that issues exist surrounding the purpose of models as part of adaptive management. Potential uses, such as Decision Support Systems, are limited if the 'model' is seen as simply a scientific output rather than supporting understanding of the implications of a range of management options.

The reflections of participants enable some distinctions to be drawn between science, management and adaptive management. In order to ensure external validity of data, scientists conducting ecological experiments prefer to control all but the studied variable and randomly assign and apply both treatment and non-treatment, with replication of both. On the other hand, managers must choose the best management option for a particular place given some particular goal. As theorists of adaptive management have indicated, managers could do with considering the benefits of learning more about what it is they are managing (Walters and Holling 1990, Parma *et al.* 1998). The reflections of the participants, and most probably a reflection of their training, tended to indicate a desire for the application of robust science principles.

Reflections on the commitment required to the scientific proviso suggest that a scientific understanding is needed both in leaders and in implementers to ensure commitment to adaptive management treatments. In all of these projects, there was specialist science support to a level of at least one full-time-equivalent scientist per project. This supports arguments from within the literature of the high levels of scientific understanding required for adaptive management. However, implementers of adaptive management may also be managers of a particular area, wherein the questions posed in adaptive management may not be those most pressing at the local level. This scenario is one reason why the implementation of adaptive management as a context-driven 'management by research' model has been supported (Anon.

2000, Gunderson *et al.* 1995). However, the model of 'research by management' is still possible under a site-based model if the same management uncertainties explored under management are those most pertinent to local goals. In one of the projects that practitioners reflected on, a perceived lack of commitment to planned management suggests that the uncertainties of concern to the participant who was interviewed may not have been equally concerning for others involved in the project. Adaptive management appears easier to opt out of when the accumulated economic costs have not been borne from the managers own budget, as was true in this case.

Whilst the use of indicators in monitoring and the standardisation of techniques is obviously essential to adaptive management, the extent of scientific uncertainty in understanding of New Zealand ecosystems and the limited funding with which to mitigate this may be seen as a limitation of adaptive management in the New Zealand context, especially in terms of its potential to 'solve' resource decision making problems.

The association between iteration issues, and an operational style of adaptive management are worthy of discussion. Experimentation involving some form of replication generally tends to be associated with a particular issue, i.e., a problem relevant to management that also invokes science interest – often from outside of a 'host' organisation. In these cases, projects tend to be specifically funded for a limited length of time, at the end of which the project is deemed 'finished', irrespective of whether uncertainties still exist. This raises issues regarding the perception of adaptive management as being associated with a more standard model of science production and delivery, as opposed to an ongoing model for management where uncertainties exist. In part, this scenario arises in New Zealand because funding for adaptive management is often in addition to ordinary funding and therefore the approach is associated with 'specialists'. Unless adaptive management is to be institutionalised, the ability to iterate is likely to be an on-going issue. An associated issue that begs consideration (beyond the scope of this thesis research) is whether there are appropriate cues for switching between experimental management (i.e., as treating management as a purposeful experiment) and a more general monitoring regime.

Learning from management experience was considered problematic by all participants from projects which had completed a full cycle of adaptive management. This is an ominous sign if the participant group is considered to reflect the practice of adaptive management in New Zealand. An important concern raised by participants is the ability for projects other than

those involved in the actual experimentation, to use the results of learning. In this sense, adaptive management can be interpreted as providing a 'public good' component, in the same way that science is considered to do. The ability to utilise this information requires consideration of organisational information management and practitioner networks. However, the involvement of appropriate stakeholders was never rated as an aspect that might or did limit management, which suggests that whilst it might be considered important to adaptive management, it was not thought of as the job of practitioners. Although not specifically identified as such, this perception may also have inhibited the ability to iterate, given that management outcomes might not be immediately identifiable to those whose support could have helped institutionalise adaptive management.

7.3 Reflections on the Participatory Evaluation exercise

7.3.1 Usefulness of the exercise

The data presented in the previous section clearly demonstrates that participatory evaluation provides a useful means of building reflection on the practice of adaptive management. In response to the question of whether participants thought the exercise was useful, all participants who completed the evaluation (i.e., five of six) stated that it was. The exercise was also considered useful as a means of building reflection on components of adaptive management less central to the professional paradigm of practitioners. The comments of one participant in particular demonstrate this, as is evident in the following excerpt:

> A Do you think the exercise is a useful one... did it help you think about your project?
> B Yes it did a lot, and I thought the cycle of questions is really good as well, so the order is good, and yes, it made me think in places, for example the social elements and maybe in terms of the overall evaluation and whether or not we concentrated too much on the biophysical side without thinking about the social and perhaps the economic side as well. So I think there's a lot of learning we could do as a result of that.

The number of project specific reflections about social processes and organisational issues that either promote the success of adaptive management or limit its utility also supports this claim.

The framework also proved useful as a tool for reflection in the early stages of adaptive management. Conducting the evaluation exercise with practitioners at this stage means that completion of the evaluation may not be possible. In these instances (i.e., two participants), I followed the evaluation process up to the step they were at and discussed potential considerations for the stages they were planning. When asked, one of these participants stated

that they would use the framework again at a later stage. The following excerpt demonstrates this point.

> A In terms of the whole exercise, was it useful? Did you start to think of things you hadn't thought about before?
> B Ah yeah, actually because I'm at the stage where we need to build a model and do this planning...these questions are actually very useful to that... to feed that into the whole development of the project.

Setting the context for the evaluation was also considered important in that it also enabled opportunity for participants to test and feel comfortable with my understanding of adaptive management, and hence determine that the exercise would be a positive use of their time. The process used included explaining the purpose of the framework (i.e., to reflect on both experimental and social aspects of adaptive management), its organisation, and a discussion of the key uncertainties that led to the adoption of adaptive management in a particular project. The following excerpt demonstrates the value of doing so:

> B: ...the discussion before we started this was kind of necessary for me... so I understood the context by which you were doing this, and we had to have agreement at the outset about what adaptive management is. So, if we hadn't agreed on that then this would have been quite difficult, but we did agree which made it quite straightforward.

The usefulness of the framework for managers was strongly doubted by one additional person who chose not to conduct a formal evaluation. They commented that "I'm not sure how happy a manager would be to use it... there's no carrot there at all... managers won't buy into it... I wouldn't use a 'pick list' like this". In response to questioning about why they felt like this, they stated that DOC already had systems in place for offering support (such as standard operating procedures), and that the framework would need simplification to a few basic principles to fit this model. This particular participant's comments raises issues regarding the delivery mechanism of a framework such as this within an organisation such as DOC. Further, they suggested that adaptive management can be implemented in a 'recipe' style, rather than with greater reflection on context, as I have argued is needed. This comment serves to highlight a limitation of conducting formative evaluation from outside the organisation in a one-off sense where it is not part of a regular institutionalised process. The intended use of the framework clearly requires opportunity to explain that it is more than a simple 'pick list' (or checklist) as has been suggested. Further, its use may require simplification, dependent on the skills and abilities of those using it. In the case of the research presented in this chapter, all participants had post-graduate training in the ecological sciences and were therefore familiar with the concepts involved.

7.3.2 Potential future use of the framework

Because of the strong science backgrounds of the participants, I also asked them to reflect on how useful a more junior level manager might find the framework. Importantly, one participant highlighted that an additional step is required prior to the use of the framework. The excerpt below indicates that in order for managers to reflect on how adaptive their management is, they must first be convinced of the uncertainty that exists in their management situation.

> B If I was trying to make a manager think about adaptive management... I'd go at it from the level of identifying the uncertainty... and maybe you've got it there... for a manager you want to throw it into their management regime. So if I was setting it up for a manager I'd say 'what do you actually know', and they'll answer you, and you say 'no, no, no, no, what do you actually know'. Because, they'll tell you what they understand, or what their paradigm is of wisdom or something. 'what do you actually know, how do you know that', and then say 'well if you don't actually know, then lets start writing down the uncertainties', Because, that's the essence of it ... [looking at the list of questions]... yeah yeah yeah, you've got that...but I think this has got to be put into their project.

A later comment from the same participant indicated that they felt there is a difference between older and younger managers (their terms) in terms of their training and the ability to understand the concepts that underlie adaptive management, suggesting that this may be less of an issue for younger managers. However, this does not necessarily mean 'older' managers will be unable to understand adaptive management, just that they are more unlikely to be trained in it.

For participants with an equal background in science and management, or with a stronger management background, I asked if they thought it would be useful for scientists. The excerpt below supports the notion that some people are more naturally reflective than others, and hence may be more likely to adopt and practice adaptive management:

> A How do you think this would go down with scientists, do you think it would be too patronising?
> B I don't think it would, if they're open to reflecting on their own science. If they're not, I think that's their problem and don't take it personally

I also asked participants whether the framework would be useful in a group situation. One had the following comment to make, suggesting that the framework could potentially play some role in determining whether adaptive management is the best style to use in any given context:

> B I think if DOC, what DOC should do with this is to sit down, and with anyone else thinking of doing adaptive management, for half a day and just go through and say well ... There's a lot of mad enthusiasm for adaptive management without a, understanding what it is or what its variants are, what it can and what it can't do ...

This comment was somewhat refreshing for me to hear, given that running a workshop such as that described was something that had initially interested me, but not something anyone

(i.e., in the Mainland Island projects) seemed interested in at the time. The framework developed in this thesis would serve as a useful starting point for such a discussion.

7.3.3 Final framework adjustments

Feedback on the questions, provided at the end of each step by participants, enabled further clarification of their wording, and even greater emphasis on both social and ecological aspects within question wording. An additional question was added to the monitoring section in order to clarify whether data had been collected that enabled evaluation of management processes. Figure 7.2 includes the final questions, with an indication of the changes that were made. An evaluation ready copy of the framework is provided in Appendix Three.

During the evaluation exercises, three questions were given black dots (i.e., deemed irrelevant), all by the same participant. In one instance, this was because they did not feel it was important to consider the social aspects of their management context, in another it was because they felt that spatial questions were secondary to their project's objectives. The third instance related to the question asking whether predictions had been developed for management options. In this case, the participant rejected the view that predictions should be made about the outcomes of hypothesis testing. The participant also questioned the necessity of another question - have the uncertainties in knowledge and assumptions in the model been acknowledged? Because the framework was designed for use with both managers and scientists, I have not excluded these questions. There may also be a need for a "don't know" response category if the framework is being used on a one-to-one or small group basis, as one practitioner was hesitant in commenting on some aspects for this reason.

Step 1: Problem scoping	
1.1: Goals	
a	**Do you have a shared vision for your project and a set of goals to match?**
b	Are the ecological boundaries of management clearly defined? (temporally/spatially)
c	Do goals consider ecological and social aspects of the management context?
d	Are goals aimed at managing uncertainty?
e	Have both social and ecological benchmarks for success been created?
1.2: Collaboration	
a	**Have relevant stakeholders been identified and provision made to involve them?**
b	Have communication networks been identified and a process for ongoing communication been established?
c	Do you have adequate capacity for your project? People?, Skills? Resources? Institutional support?
Step 2: Model building	
a	**Has a model of the system being managed been developed?**
b	Have relevant sources of knowledge been identified and drawn together to use in the model?
c	Have uncertainties in knowledge and assumptions in the model been acknowledged?
d	Have issues associated with both temporal and spatial scales been considered (e.g., lag effects or invasion risk)?
e	Is the model translatable for stakeholders and policy makers?
Step 3: Action	
3.1: Planning	
a	**Have management options been identified that meet goals and are they stated as hypotheses?**
b	Have predictions been developed for each option?
c	Have stakeholders been included in decision-making?
d	Have the risks and trade-offs between different management options been considered?
e	Have ecological imperatives been considered equally with economic and social imperatives?
3.2: Science considerations	
a	**Have management actions been designed as experiments and are they recognised as such?**
b	Have the limitations of methods been recognised?
c	Has focus been given to the biological significance?
d	Have compromise and constraint been accepted?
e	Has an appropriate running time been considered for experiments?
Step 4: Monitoring	
a	**Is monitoring conducted systematically and in relation to hypotheses?**
b	Are short and long-term responses monitored?
c	Are appropriate criteria used in indicator selection?
d	Have relevant stakeholders been given an opportunity to be involved?
e	Has data been collected so that management processes can be evaluated?
Step 5: Evaluation	
a	Is evaluation conducted systematically and in relation to goals?
b	Are both process and experimental lessons documented?
c	Is the management process transparent?
d	Is the process iterative?
e	Is evaluation completed in relation to the timing of ecological processes?
f	Are failures and unexpected results treated as learning exercises?
g	Are both social and ecological uncertainties evaluated?
h	Has the appropriateness of goals been evaluated?
i	Are management and learning processes evaluated?
j	Are practitioners and organisations self-critical?

Figure 7.2: Refined adaptive management framework. Blue circles represent changes made to improve clarity, red circles represent changes made to question emphasis, and the yellow circle represents a new question.

7.4 Chapter conclusions

The goal of the exercise presented was for practitioners to be more reflective on their use of adaptive management. To these ends, the framework and the process used to introduce it to managers were successful. The adjusted framework, as it stands, is clearly a useful tool. Future application should consider its usefulness in helping groups to reflect on their use of adaptive management. The integration of the outcome of evaluation into project planning is cited as a key way of ensuring relevance by a number of academics (Wholey 1991, Rotham 1998, Fetterman 1999, McAllister 1999). A limiting factor in the way evaluation was used in these exercises was that there was no assurance that the learning of participants would be channelled back into the projects themselves, although some participants indicated that the outcomes would be useful in report writing and project planning. One way of increasing confidence in evaluation integration might be to complete the evaluation within a group setting. Whilst this was desired with Mainland Islands, attempts to initiate such an exercise proved unsuccessful.

By using the framework as a basis for cross-case evaluation, key issues for the practice of adaptive management in New Zealand were identified. In particular, the need for commitment to the scientific proviso, which prevents changes in periods of management and in monitoring within stated time-frames was noted. Emphasis on the 'scientific proviso' is indicated in concerns regarding the uptake of models that provide a template for assessing change in management uncertainties. Further, concern regarding the ability of some projects to iterate suggests issues exist within DOC in terms of institutionalising adaptive management. While some arguments are made about potential reasons for this in the conclusions chapter, it remains an organisational issue that requires further research in itself.

The use of the framework in this thesis has been limited to cases where the application of adaptive management is explicitly desirable or already occurring, and managers are interested in reflecting on projects as a whole. Access to these types of cases may not always be possible (as occurred with the Mainland Islands – see Chapter Six). There is hence a case for exploring alternative approaches to building reflection on management processes in order to support the adoption and practice of adaptive management. It could be argued that building understanding about the role of reflection in adaptive management is limited to cases where it is already considered an appropriate or desirable approach. However, this ignores the potential for

introducing adaptive management in a more limited way, and learning about how to support its adoption and practice in a way that may be less threatening, i.e., in a more limited scope. In Chapter Eight, I introduce two research cycles where two alternative approaches to building reflection in parts of management were initiated.

Chapter Eight: Alternative reflection building approaches

8.1 Introduction

Throughout this thesis, I have argued that reflection is required on adaptive management as it relates to the context of management practice. The second overarching research aim can thus be thought of as developing understanding about ways in which to support increased reflection on context throughout the practice of adaptive management. My initial approach to this has been to develop and test a framework designed for formative participatory evaluation (Chapters Two, Five, Six and Seven). However, a range of reasons, such as lack of financial resources or time, or lack of perceived benefit, may preclude projects from undertaking such an evaluation. There is therefore a case for exploring alternative approaches to reflection which can be used at different scales (i.e., involving part of a project's management, rather than the whole of the project as the evaluation framework exercise does).

The purpose of this chapter is to introduce two alternative approaches (joint inquiry and individual reflection on group process) and assess their value for building reflection. Thus, the chapter represents a combination of research cycles four and five (see Table 3.3, Chapter Three for details of research cycles). These cycles share a focus on specific parts of project management as opposed to the 'whole' as the evaluation framework did. They also share the assertion that explicit reflection and learning about part of a project is valuable in its own right. Whether or not this leads to improved capacity to manage adaptively in other parts of project management is beyond the scope of the research presented here. The first of the two anecdotal case studies (research cycle four) involved a joint inquiry conducted with Mainland Island staff on the topic of information extension. The second (research cycle five) involved reflecting with individuals on their experiences of the group activities within the Forests Affected by Deer project. It also represents an opportunity to explore means for mitigating my concern, arising from research cycle four, that individuals have the potential to disrupt the progress and thus limit the success of adaptive management.

This chapter firstly introduces and provides detail of each research cycle, including the activity and its purpose, key findings, and reflections. It then progresses to discuss the contributions of the cases to understanding the practice of adaptive management. Given that both research cycles were designed explicitly as intervention to ongoing project management, they enabled me to gain additional insight into the establishment of adaptive learning

processes. My reflections on these exercises are therefore used to argue that a number of tensions exist that must be considered if adaptive learning and management are to become established. Figure 8.1 provides a summary of the analytic process used.

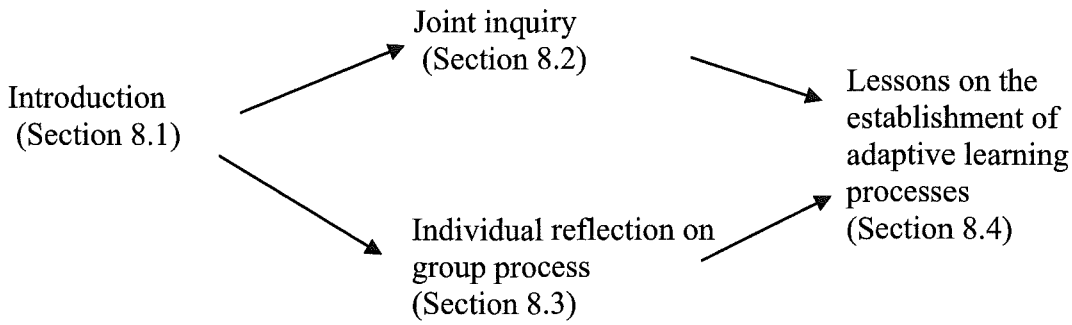

Figure 8.1: Analysis schematic for the chapter

8.2 Joint Inquiry

Research presented in Chapter Six indicated that there are significant issues regarding the ability of the Mainland Islands to be truly adaptive in their management process. Discussion of decision-making and evaluation processes indicated that assumptions are rarely stated even though participants indicated that this is an important part of managing adaptively. These results suggested that project staff are capable of developing management objectives and plans and monitoring them, but are less able to make sense of that information because of a lack of clearly stated hypotheses and assumptions against which to evaluate. Joint inquiry, as described in Chapter 2.5, has the potential to both build and demonstrate the reflective capacity that I argue is essential for adaptive management.

The inquiry presented in this section focussed on the topic of information extension. Mainland Islands have asserted that a significant part of their role is the transfer of biodiversity management information. This is evident in notes from the 2004 Mainland Island Hui, where project staff identified that two of the purposes of the projects are "learning how to carry out ecological restoration and do it more effectively and efficiently..." and "to transfer understandings, techniques and learnings derived from this set of projects to others within DOC, to the wider communities within and beyond New Zealand, to increase the capability for ecological management and restoration" (Glaser 2004:87). Whilst all of the Mainland Islands are recorded as having advocacy programmes and objectives (Saunders 1999), information transfer outcomes are commonly reported on by means of listing the ways in which information is provided. The aims of this research cycle were thus to demonstrate that Mainland Islands contribute to biodiversity management capacity and, in doing so, explore

the ways in which joint inquiry can be used to build reflective capacity required for adaptive management.

8.2.1 Establishing and conducting the inquiry

The topic of information extension was first mooted in 2003 in feedback from a scientist within DOC who reviewed a report of research results presented in Chapter Six. With the arguments above in mind, I approached staff from individual Mainland Island projects that exhibited a more pronounced need for adopting adaptive management more fully, i.e., in a way that utilises models to illicit knowledge gaps and explicitly tests assumptions about management actions. Three projects were identified as meeting this criterion; Trounson Kauri Park (TKP), Northern Te Urewera Ecosystem Restoration Project (NTUERP), and Rotoiti Nature Recovery Project (RNRP) are all sites that involve the management of ecosystems with both ecological and social uncertainties that require developments in management capacity. Importantly, they were also identified as sites where both local support and strategic level Department of Conservation (DOC) support are necessary. Thus, the inquiry on information extension was relevant because it had the potential to demonstrate project value other than by a simple biodiversity performance indicator.

I met both formally and informally with staff from these projects over a period of six months at Hui, conferences and in person. Attempts to initiate and conduct the inquiry proved successful at only one project (RNRP) although the process used to approach each project was similar. One project simply adjusted their monthly operating report to include indicators of information extension and suggested I independently test whether recipients got the information they asked for because they doubted "we have the means or wherewithal to research this assumption within the project". In another project, staff who appeared very interested identified that they had not been tracking information requests because there was no one staff member at the site who took responsibility for the inquiry. Reasons for the lack of success in establishing the inquiry with these projects are discussed later in this section.

At RNRP, I met with both the operational and management staff on three different occasions. They discussed the significance of the learning focus of Mainland Island projects that was, in their view, not supported by upper level management, resulting in what was described as "an incremental erosion of our ability to learn". A staff member suggested that their choice to participate was influenced by the response to the question, "will it help me to be a better manager?" Staff noted concerns regarding the amount of time such a project might take, and

that they felt it was not their responsibility to demonstrate transfer. During the inquiry process, I kept regular contact with staff via email and telephone, and spent two days at the project facilitating analysis and interpretation of the data that had been gathered. A staff member involved presented the results of the inquiry at the 2005 Mainland Island Hui. An outline of this presentation is provided in Appendix Four in order to highlight staff interpretation of the work.

In addition to the interests of staff in measuring their contribution to information that supported management capacity, I was interested in exploring the ways in which the inquiry (based on the steps of the adaptive management process) could be used to build the reflective capacity required for adaptive management. My role in the inquiry was thus to support staff in reflecting on it. I asked staff to explain why they suggested the changes to the inquiry that they did and the implications of this for attaining the goals of the inquiry. I also provided support with regular checks on progress, and spent a substantial amount of time preparing project outlines, and draft copies of data forms for comment given the initial concern of staff about the time-commitment required. I always ensured that staff had control of decision-making about research directions and methods used given that my interest was in their learning process. In addition to the inquiry itself, I held an interpretation exercise, where I asked staff to make predictions about the results. These predictions were then contrasted against the actual results, enabling reflection on information transfer in the context of RNRP. A transcription of this exercise was used in the analysis of the value of the inquiry in building reflection. A brief outline of the inquiry itself and key findings are included in the following section to provide background to this reflection exercise.

8.2.2 Inquiry details

The inquiry itself involved development of a conceptual model of information transfer, measurement of information requests and measurement of secondary reporting. Information requests were noted for a period of one year and categorised in relation to the species of interest, so that staff could identify the type of biodiversity management capacity they were contributing to. Request source was also recorded, so staff could identify who was using the information. The second data set provided a means of determining whether RNRP was given credit for information sourced from the project and thus provided a means of determining the visibility of contributions made.

Inquiry findings indicated that 55.1% of information requests came from outside of DOC, thus indicating that RNRP has a significant public profile. Requests for information on rats and wasps accounted for 44.9% of all requests although requests from within DOC were more likely to be for information on rats (50% of DOC requests, as opposed to 16.3% of all requests). These requests types are reflective of RNRP management foci and, in particular, the involvement of one staff member on the DOC rodent control Best Management Practices Network group.

Data collected on acknowledgement of RNRP in secondary sources (i.e., journal articles and reports where information was contributed to or collected by RNRP) indicate a lack of acknowledgement (47.8%, n=23), especially for wasp information (85.7%). Although a comparison was not made to other projects, this finding does indicate that the visibility of RNRP contribution is low. Key lessons from the RNRP report (Butler 2003) identified elsewhere indicate a tendency to emphasise developments in the management of stoats.

In addition to monitoring requests for information, staff estimated time spent on information transfer, which was estimated to be 6% of each of the full-time workload of two staff involved. Given that the role of these staff was primarily operational, and no part of their workload is officially allocated to this, it represents a significant part of their time that can now be allocated for in project planning. A comparison with other DOC staff whose roles did include an information transfer component was made. Wright *et al.* (2003) indicate that scientists average 4-4.5% of their time responding to written requests for information, while they spend a total of 82-96%[27] on a range of other tasks associated with transfer. Staff at RNRP are obviously perceived to hold some specialist information of value to others. Staff reflections on this exercise are presented next as they are pertinent to developing understanding about adaptive learning processes and thus to assessing the value of the inquiry for building refection.

8.2.3 Reflecting on the Inquiry

When analysing reflections on the inquiry, I looked for evidence of the different levels of reflection outlined in Table 2.1, Chapter Two. I also compared evidence of reflective capacity before and after the inquiry. In initiating the inquiry, staff demonstrated some capacity for reflection already existed. For example, staff challenged what was described as the "constant

[27] These figures appear somewhat suspicious given that these individuals are primarily employed to do research!

questioning" of Southern Regional Office as it related to demonstrating achievements. They also challenged whose role it should be to demonstrate information transfer. These comments indicate consideration of problem context (i.e., the third level of reflection outlined in Chapter Two) from the outset. However, they may also be seen as a defence mechanism to confronting the possibility that the value of Mainland Islands could be demonstrated to be less than first thought, or that that idea was irrelevant. The latter of these possibilities is rejected given that participants did choose to participate in the inquiry. I accept that this response was a combination of the first two reasons identified.

A key part of this exercise was getting staff to reflect on the data in relation to predictions they made about it. The following illustrative excerpts demonstrate that when asked why some data were surprising, staff were able to reflect on the limitations of the data collected. This level of reflection is equivalent to that of level two – reflecting on assumptions.

Excerpt 1 – reflecting on the source of internal requests

A So is that different to what you expected?

B It is a bit, yeah. I kind of got the feeling that I spent most of my time giving information to {name excluded}

A Well, you might have spent most of your time, like {name omitted} said that's the problem with

C Yeah

B yeah, that I spent most of my time giving information to {name omitted}! laughter

A Like I said, {name omitted} that's the problem with that form it doesn't show where you spent most of your time

Excerpt 2 – Reflecting on the implications of low levels of acknowledgement

A I would hate to even contemplate at a guess. Ideally, if they took information from this project, it should be 100% acknowledged.

Shown figures...

A That's pretty shocking, yeah, that's absolutely shocking

B It does show a lack of academic standard

A It does eh.

C It's department and external people, collecting and using your data

B Actually, that happens to be one of the issues that's so frustrating. People like Landcare are grabbing our data and using it

Reflections of staff on the inquiry itself demonstrate both level two and three reflection. The first of the excerpts below indicates a process of making meaning. The second demonstrates the ability to reflect on the implications of study for information transfer from RNRP.

Excerpt 1:

B Well I was really interested to see just how many inquiries I fielded, because I always make these comments about how, maybe, getting my own email has increased my workload, and it was quite good to be able to quantify that actually. And as it turns out the most I've fielded in a month is 4 or 5.

Excerpt 2:

B We write a business plan and it would be pretty hard for us to say 'here's the business plan, we know that a week of our time is going to be required for this. We can't remove that from the business plan basically because what it requires is the area manager to say 'look, I fully encourage you to hand up the phone every time someone rings up, or there's a request, just do not bother to answer an email, or say sorry, I'm not answering it. Because that's one of the things, as public servants, we're expected to be accessible to the public.

Further evidence of level three reflections (i.e., on the problem of information transfer) include the following excerpts. The first was in relation to whether staff would continue to monitor information transfer as they had been. The second shows reflection on individual's roles in the information transfer process.

Excerpt 1:

A I would continue to do it because we pretty much sort of need to. We always include a section in the report about spreading the message or something. Particularly for important bits of information really...and particularly when you know you've given advice and you're going 'that might bite me', then you record it as well. I can think of a classic case.

B We need to have a mandate to do that though, to do the recording. Like it was easy this time because it was going to your study, but we need a commitment in our official plan basically for it to have enough momentum behind us to do it, to know that it's going to be used.

A The mandate's actually an interesting one because we don't actually have a mandate to provide the information

Excerpt 2:

A I would never have expected that to be my role when I took on this job, that I would spend that amount of time dealing with information provision

B Yeah, same to me

A When I first took on this role I thought that that was other people's jobs, and that I've become quite surprised at how many specialists occupy ranger positions

An analysis of these reflections, in conjunction with the less successful inquiry attempts, is useful in identifying lessons about the establishment of adaptive learning processes.

8.2.4 Implications of reflections

The reflections presented above clearly indicate capacity for the facilitation of level three reflection (reconsideration of the problem) through the use of joint inquiry. The structure of reflections did not however demonstrate orderly transition from one level to the next. Increased depth of reflection did occur towards the end of the exercise.

I also asked staff if the way we worked was different to the normal process of research and whether the premise of participatory research, i.e., the argument that involving people in deciding not only what to research but in the process of research means that the research is more relevant, and that participants make other gains from their involvement, was valid. One of the inquirers stated that they agreed with this assertion. Another identified that the process of working was different to that of working with other researchers. Another indicated the most

pertinent outcome of the inquiry, from their perspective, by stating "I think the key message there is, as I say, is get off our case, we are doing it, help us do it rather than just give us a hard time and pretend that it's not happening".

Reflections on the data from the inquiry and on the inquiry itself indicate that joint inquiry has the capacity to demonstrate, and potentially build, reflective capacity. Whilst there was evidence that all levels of reflection are required in adaptive management, a limitation is that this does not necessarily mean that reflective capacity will be transferable to other situations. What has however been demonstrated is that the process used in working with this group provided a means for staff to be reflective and use information in purposeful ways, as is needed for adaptive management. To this end, they have demonstrated by exemplar that capability exists for adaptive management.

Whilst this attempt at the inquiry proved successful, both in providing useful information and in building and demonstrating reflective capacity, other attempts did not. The first response, i.e., to include information transfer activities into regular planning and reporting is suggested to represent a passive-adaptive learning model (see Chapter Two for details of this). It could also be argued that staff were not convinced of the potential benefits of being involved in an inquiry, or that they did not value them. Whilst in the second case staff were able to identify the benefits of the project (one staff member noted that "your work would really support what we are doing"), other barriers to change obviously existed. A phone call to a staff member at this project to check on progress with the agreed information tracking system revealed a lack of internal leadership. However, they noted the potential value had they done so. A lack of clearly demonstrated achievements relating to asserted project purpose had resulted in an inability to demonstrate achievements to a level desired by more senior managers. As a result, the project faced potential funding cuts, and staff were left "fighting fires", rather than producing outcomes, adding that "your work would really support what we are doing".

A comparison of RNRP with the less successful inquiry attempts suggest that if joint inquiry is to be entered into, then there must be perceived benefit in it and that individuals must take responsibility for the inquiry. Hence, individual motivation may affect the group inquiry process. My reflections on the failed attempts at co-operative inquiry in this chapter raised an important consideration in the practice of group work: that individuals' perspectives on what is desirable, and how it should be achieved differ, and can affect the desire to be involved in group processes.

8.3 Individual reflection on group process

The fifth research cycle involved working with individuals to reflect on activities that formed part of a larger parent project. The parent project, the Adaptive Management to Restore Forests Affected by Deer (FAD), was at the beginning stages of adaptive management. In addition to being used in combination with data from the joint inquiry outlined in the previous section to reflect on the establishment phase of adaptive learning, it is useful in its own right to build on understanding about the social learning process inherent in adaptive management (see Chapter Two for a description of this). It is assumed that by involving individuals in reflecting on adaptive management, insights can be gained that could be useful in designing a process more responsive to the needs of individuals engaged in it.

Semi-structured interviews were conducted with 20 FAD participants who were asked about activity strengths and weaknesses; these were analysed in relation to emergent themes. Three key themes (project purpose and roles, people, and process) provided means of comparing different perspectives of scientists, DOC managers and Affected Forest Users involved in three site-based learning groups. While individuals may fit a combination of these perspective groups (e.g., DoC staff and Affected Forest User), I have grouped participants into one or other of these categories. Classification was based firstly on whether or not they were scientist, and secondly, on whether or not they worked for DOC. The first criterion was deemed important as it was likely to affect their interest in and expectation of the project. The second criterion was used given that it was likely to affect others' perceptions of their motivations and interests. These categories are also considered useful given that each perspective type was involved in the project to differing levels – scientists in an over-seeing role (i.e., in all learning groups), DOC staff in identifying learning group members and providing operational support to the project, and learning group members in identifying uncertainties to be explored in management and in scrutinising research planning.

As part of this project, summaries of the data collected after learning group activities were provided to the project so that they could be included in the design of subsequent learning group activities. This is similar to the work of Grant and Curtis (2004) who used feedback from participants to refine a group process. However, the use of repeat interviews for feedback in this study, as opposed to randomly selected participants, was deemed to be additionally beneficial by providing a means of determining whether individuals' concerns had been mitigated. Thus, follow up interviews (n=9) with participants after subsequent

learning group activities provided an opportunity to monitor changes in perspectives. Timely access to contact information and the fact that not all learning group members were present at subsequent activities limited this sample size. Information of changes (i.e., resolution of concerns, what has been learnt and changes in relationships) is also presented.

Whilst this case-study may be viewed as an opportunity to have further tested the framework developed in Chapter Seven, my interest in individuals' experiences, given their differing roles in this project and a desire to develop alternative approaches for building reflection, means that the framework has not been used in this research cycle.

8.3.1 Individuals' reflections on adaptive management

Participants identified a range of factors that affected their experience of this adaptive management project which are summarised in Table 8.1 under tree themes: (1) project purpose and roles, (2) people involved, and (3) process. Some factors were similar across perspectives (shown in bold), but others were not. Other than where indicated, these perspectives are representative of all site-based learning groups.

Table 8.4: Opinions from different perspective groups on FAD process. Note that numbers in brackets represent the number of individuals commenting on a particular aspect. Issues show in bold are those common to more than one perspective group.

Theme	Opinions from Science (n=5)	DOC staff (n=3)	Affected Forest Users (n=12)
Purpose and Roles	**Feeling like they are expected to be a learning group member and an expert (1)** Don't feel that science concerns are taken equally (1) Do we have the right skills to answer questions? (1)	**Feeling like perceived conflict of interest because of interests and organisational representation (2)** Making good decisions (1) Understanding community perspectives (2) Communication between the project, DOC and the public (3) Insure information is useful for managers and ensure its use in future decisions (1)	**Feeling able to represent own perspective rather than those of a user-group (1)** Conclusion on deer-forest interactions (8) (although clarity in direction needed (4)) Providing local knowledge (2) Involved to build credibility (5) Too much to expect them to design science experiment (3) Are "pawns in the study" even though they feel valued (1)
People	**Characteristic of individuals in the groups have worked well (3)** Attrition issues linked to groups (2) Missing some key stakeholder groups (2)	**Characteristics of individuals in groups have worked well - they are all open minded and not on "a high horse", but some individuals have the potential to disrupt the process (2)** Issues of "DOC-branding" exist in the groups (2)	**A good diversity of people who are willing to change their perspective and not overtly political(6)** Some people from different roles may be less passionate than others (2), but that's not a bad thing Volatility of groups need strong facilitation and leadership which we have (2 groups) (5)
Process	**Transparency issues regarding awareness of other groups (2)** There is a willingness to work together (1) Getting the groups working has been more important than a tightly structured and designed process (3) No-one but plant scientists knew how little was known about plant animal interactions (1) Science vs. management: (3) Potential divide between biophysical and social science perspectives (1)	**Transparency important (1)** **Language has been too technical at times, and the presentation of it too fast (1)** **Strong facilitation and leadership have been essential in managing relations and gaining trust (3)** **Good encapsulating of ideas (1)** **Field trip was "very necessary" (1)** **Notes between meetings are valuable (1)**	**Transparency (7)** **Too much technical language at times (2)** **Facilitated and well run process (9)** **Integrity in process (7)** **Good at seeing the big picture including the ability to see individuals' contributions (2)** **Field trip** **Communication (5)** Science (7)

Purpose and roles

Participants indicated different perspectives on the project purpose than those outlined in the Research Investigation form. While scientists did not comment specifically on this, DOC staff identified with purposes specific to their role, and Affected Forest Users were most interested in the ability of the project to bring closure regarding the affects of deer on forests. Across all perspective groups, the notion of "wearing multiple hats" was common. Participants felt like the 'represented' many different perspectives – including their affiliated forest-user group perspective, their affiliated organisational perspective, and their own personal perspective. This was described by one scientist as "almost a schizophrenic experience", by a DOC staff participant as an uncomfortable "sitting of the fence", and by Affected Forest Users as a lack of comfort given their lack of familiarity with the process involved in the style of adaptive management being implemented. Role clarity was an issue for almost all of the Affected Forest User perspective group. Some asserted their role as locals and their contribution as local knowledge, i.e., as "care takers of the land". Others suggested their presence was akin to "having someone in the tent so they don't poo-poo the results". For some individuals from this group, being expected to be involved in experimental design was too much, and a more science driven process was desired.

People

A commonly held perspective was that the characteristics of learning group members (including being willing to change adapt their individual perspectives and not being too radical) had resulted in groups that worked well. A point of note here, as discussed in Chapter Four, is that learning group membership selection was based on attempting to ensure successful working relations rather than convincing the most radical of views. While providing a range of other information, participants' reflections were focused on process issues.

Process

Similarities in perspectives from the different groups included a desire for quality science outcomes. Within the Science group, this was described as a need for information to be as defensible as possible. As a consequence, discussion on the differences between science for the sake of science, and science for the sake of management ensued. Differences in perspective within this group included the level to which site selection and question development should be expert driven. The desire to gain conclusive results on the affect of

deer on forests drove their interest in quality experimentation by both DOC staff and Affected Forest Users.

Another similarity between perspectives included a need for transparency. This was expressed by participants of Science group as a concern that learning groups did not know about each other, by DOC staff as avoiding the project being "a secret squirrel thing", and by Affected Forest Users as a desire that "everything is above board". The use of technical language was a concern raised by those without a science or technical background. Both DOC staff and Affected Forest Users identified the significance of issues relating to process integrity. The ability to encapsulate the ideas of non-specialist participants and respect the knowledge they bring to the process was seen as crucial to their ability to participate in a meaningful way. Of particular note was the notion of local knowledge and how it is valued and represented in the FAD process. The following two excerpts from different interview notes emphasis the way in which this form of knowledge is often disregarded.

> Excerpt 1:
> S/he made a comment that if he were Māori, this knowledge would be valued in the form of oral history, but as a farmer it has to be written down to be true, and even then it has to be in a special format.
>
> Excerpt 2:
> [S/he] adds that there is a trend that some academics and those in DOC not involved on the ground level have a tendency for them to miss the local knowledge. I commented that this was something I had seen before, and that I thought it was about the fact that whilst Māori are consulted and their history is considered, the Pakeha cultural perspective or local knowledge, especially where it exists in those farmers and people with a strong connection to the land that had developed over many years, seemed to be largely ignored – that it actually existed but wasn't recognised. [S/he] responded by saying "you've nailed it".

Descriptions of the process by the science group, i.e., as less structured, and back to front are encapsulated in the quote below:

> Vaguely, you go into these things thinking it's messy and not knowing how it will turn out. It's just that the circle [i.e., the adaptive management process] is never very evident or it can be less evident in practice. Sometimes you have to let things go, they're not wrong, it just is, even though it's tempting to say it's wrong.

Specific activities were also identified as significant, including the fieldtrip and between-meeting communication which contributed to the provision of opportunities for learning and a sense of openness in the project. In addition to noting several opinions about the process of adaptive management, individuals reflected on changes that occurred over the course of their involvement in FAD.

8.3.2 Changes over time

Reflections from the interviews detailed above and from repeat interview enabled changes over the course of the project to be identified. These changes are presented in relation to learning, relationships and other changes.

Learning

Implicit in the definition of social learning[28] is the notion that something is learnt from a engagement process. As part of the FAD process, individuals from different groups identified different learning outcomes and different processes that contributed towards them, as noted in Table 8.2[29]. This table groups scientists separately from DOC and Affected Forest User group perspectives given that the level of pre-existing ecological knowledge and experience with adaptive management processes differ in this way.

Table 8.2: What was learnt by different participant perspective groups

What learnt?	Specified contributing factors	No.
Scientists		
Project differs to others in New Zealand – use of the term in New Zealand shows less scholarship and experience	Interdisciplinary team	2
The model building process used in FAD has been "cart before the horse" and "sort of back to front". People feel they are "in a zone where no-one has gone before" and that this process is misrepresented in the international literature	A broad topic Desire to incorporate and demonstrate progression from rich picture to model Desire to be inter-disciplinary and link all system parts	4
Can get to the modelling phase in a less-abrupt way	Interdisciplinary science team	1
Whole system processes are messy	Research team and learning group relations	2
DOC staff & Other Learning Group Members		
Forests	Field visits and discussion by plant scientists	11
About the bigger picture	From listening	4
How to work with communities, including the value of listening	From observation	1
About range of perspectives (sometimes conflicting) within the hunting community	From discussions with other learning group members	1

Overall, the project was considered a successful exercise in relation to learning, particularly for learning about forests. Some participants indicated that the process has challenged their

[28] Social learning is defined by Keen *et al.* (2005:4) as "the collective action and reflection that occurs among different individuals and groups as they work to improve the management of human and environmental inter-relations".

[29] One of the goals of the FAD project is to produce a framework for conducting adaptive management (as is noted in Chapter Four). Hence, participating scientists were asked directly what they had learnt about adaptive management.

assumptions about the effects of deer on forests, one of whom added that the site visit they found "the exact opposite of what you thought you were going to find". For two others, learning about forests and forest processes had changed their experience of being in the forests, saying that "it makes me look harder" and that it "has changed my horizons". Another participant also noted that it had led to a realisation of how little they know, and a desire to learn more.

Changes in relationships

Social learning theorists have argued that involvement in processes such as adaptive management has the potential to lead to profound changes in individuals' perceptions (Keen *et al.* 2005). Participants' reflections on the relationship between this project and DOC, indicated strong anti-DOC sentiment aimed at senior levels in DOC management. These included comments that they are "big time pre-determined", "so out of touch with reality", that forest users have "absolutely no faith in them", and that DOC is "less than the sum of its parts". These comments demonstrate the degree of sentiment that existed at the initiation of the FAD project. Importantly, participants commented on substantial changes in their perspectives over the course of the parent project.

Reflections by DOC managers indicate that improved local relations were desired as an outcome of involvement in FAD, as is evident in the comment of one manager who stated that s/he wanted learning group participants to "walk away thinking they could stake their reputations on it". Another used examples from Australia to indicate the potential consequences of poor community relations and the importance of longer-term community relation building efforts, stating that "what we forget on this side of the fence is that they are just as passionate as we are and if you cross them you better watch out!" In addition to perceived changes in relationships between themselves and forest users involved in FAD, DOC staff indicated interest from other staff from their Area Offices and Conservancies in the processes used and the potential to transfer these to other projects and areas of work.
One DOC staff member identified an anti-green sentiment after the first meeting, stating that "they all think DOC are {deleted expletive}", after the second meeting s/he said that this tension had subsided and that trust was "60% there". Another stated that working at the local level using processes such as FAD can enable user groups to "see they're [i.e., DOC] not complete {deleted expletive}".

Given the potential to improve local level relations, it is perhaps unsurprising that concerns were raised about the interaction between different management levels in DOC and the effect of this on FAD. A DOC staff member raised concern about the potential for 'micro management' by more senior levels of management and the flow-on effects this would have for community relations, whilst another expressed sadness when other DOC staff did not see the same amount of value in trying to prevent bias in science. Affected Forest Users expressed this concern both directly, as can be seen in the following quote "DOC on the ground are good guys, but the dick heads in Wellington could stuff the whole thing up", and indirectly, for example that the learning group needs to realise the project "can't be all things to all people". Through the presence of FAD, DOC (as an organisation) was now perceived to be "fighting fires at the bottom rather than letting them get too big".

Other changes

In addition to changes in relationships, additional ways (other than individual learning and relationships) in which perceptions of the FAD changed over time, and the aspects of the project that contribute to these changes are identifiable. These changes, summarised in Table 8.3, indicate that after initiation, messy projects such as FAD go through a period of settling whereby project purpose and individual roles are clarified, scepticism decreases, and individual comfort increases.

Table 8.3: Identified changes in perspectives on FAD over time and aspects that contributed

Change	Aspects that contribute
Increasing comfort in the purpose of the project	Process integrity Transparency
Decreasing scepticism about the project and DOC	Social activities Confidence in group setting
Increase in role clarity	Feeling able to present own perspective
Individual comfort	Science presentation and use of technical language Sense of achievement

8.3.3 Implications for social learning

Participant responses portray many of the factors identified as supporting social learning in adaptive management (see Chapter Two for more detail), as are summarised in Table 8.4. Many additional factors that build on these were also identified. Issues common across the different stakeholder groups included: a diversity of perspectives is valuable for group process, but only if they are open-minded and prepared to change rather than threaten the ability of the group to work together; consideration needs to be given to the multiple

perspectives individuals may bring to a process and how they can best be used to contribute to that process; there is a need for effective communication between meetings and to provide support for individuals who are interested in learning more. Lastly, there is a need to support individuals through what appear to be naturally messy processes, especially those who lack experience in participatory processes and who may otherwise become disillusioned with the process.

Table 8.4: Factors that support social learning: comparison of perspectives on FAD against those from the international literature presented in Chapter Two

Factors that support social learning	Portrayal in FAD
Early and continuous involvement supports increased understanding of issues	Ability to see ideas incorporated
Hands-on opportunity	Field trip value
Comfortable environment	Integrity in process
Understanding cultural issues	Valuing local knowledge
Good relationships	Learning groups well facilitated Integrity in process Transparency
Team work	*No particular mention*
Ability to influence decision making / Inclusive process	Integrity in process
Clear goals	Clarify purpose
Implementing project as agreed	Desire for material to be delivered in a more timely manner
Conflict management / Skilled facilitation	Facilitation and leadership valued
Tangible outcomes	Science quality important

Participant responses also portray many of the factors identified as limiting social learning, (summarised in Table 8.5). Many additional factors were also identified. Issues common across the different stakeholder groups included: limited direction setting by science staff (although this is traded with valuing and incorporation of local knowledge); limited assurance that the science is right and will produce an answer; limited clarification of roles and the provision of information to support asserted roles; and domination of meetings by language that is privileged to only some of the group (e.g., science concepts and language).

Table 8.5: Factors that limit social learning: comparison of perspectives on FAD against those from the international literature presented in Chapter Two

Factors that limit social learning	Portrayal in FAD
Mismatch between expectations and delivery	Clarity on purpose
Difficulty in keeping focus	*No particular mention*
Fear of risk	Desire for use of results to gain conclusion on the effect of deer on forests Transparency
Expectation of passive learning	Use of technical language, level and timing of science direction
Lack of knowledge	Lack of clarity of role / confidence
Lack of process planning	*No particular mention*
Inexperience with participatory process	Lack of role clarity
Less-positive prior encounters	Relationships can change over time

Given that specific research questions were not asked about either factors supporting or factors limiting social learning, the issues identified within FAD represent comments made in relation to more general questions about project progress. Further, many of these issues may since have decreased in significance. The issues identified provide a useful set of context specific indicators against which to monitor the attainment of participatory outcomes over time in subsequent learning groups and potentially in other projects as has been suggested elsewhere (e.g., Grant and Curtis 2004).

8.3.4 Implications of reflections

Reflections from participants indicate that all three levels of reflection (i.e., reflection on action, reflection on assumptions and reconsideration of the problem) were evident. Participants whose reflections were identified as level three were all apparent in the first occasion I discussed the project with them. This observation has implications in that it suggests people are naturally reflective, as opposed to the notion that reflection must be either built or facilitated. However, during repeat discussions with participants, increased emphasis on the second and third levels of reflection was apparent.

Reflections indicate three areas of potential concern for project success, the first of which is apparent when considering differences between themes raised by the Science and Affected Forest User perspective groups. Firstly, the strong association of participants with the need for their own ideas to be incorporated in the group process appears at odds with the desire for

stronger science direction of the process. Reconciliation of these issues requires attention to how the value attributed to local knowledge and its incorporation in the process, the concerns of scientists about equal consideration of their concerns and the concerns for management usefulness can be adequately incorporated at different stages in the working process.

Secondly, whilst it is reasonable to expect a quality science process, the generalisability of experiments and the application of outcomes to national level policy decisions (considered a desired outcome by some individuals) is unclear as it will most likely remain until the end of the project. Whilst increased involvement by senior level DOC managers might go some way to resolving this tension, it would act to reinforce a third area of potential concern in these reflections, i.e., ensuring relevance at the local and national levels..

Although local level relationships between user groups and DOC were indicated to be improving, a third area of potential concern (raised by participants in this study) exists between a desire to ensure more people know about the project so as to support the outcomes and the potential for micro management that may undo the trust-building that has resulted in improvements in relationships at local levels. This concern reflects an issue identified within theory on adaptive management (introduced in Chapter Two) on the trade-off between ensuring scientific rigour and the need to incorporate stakeholder perspectives at the local level in order to gain support for adaptive management. This tension is also indicative of that identified in resilience theory (Gunderson and Holling 2002), whereby lower level systems within a hierarchy (in this case organisational hierarchy) depend on social resilience in order to absorb changes from higher levels. Challenges to resilience in these cases will provide a strong test of the relationship building that has occurred at the local level.

Feedback from the facilitation team (incorporated in the Science perspective group) on the benefit of this information was positive. Specific feedback identified as useful included that learning group members felt they were representing multiple perspectives, that members were concerned about the level of technical detail and its presentation, and that the project could have been more science directed. One member concluded our discussion by saying, "I actually think it's important to record this sort of stuff. You don't think of it separately from the [parent project] notes, they reinforce each other". This comment is important in that it indicates that contributions to process design came from a range of sources in addition to this study, but that it was useful. Another noted that they remembered one email (which was referred to as "really good"), but commented that "the idea of finding out how people feel

remains valid, but when the project is going well, it's kind of superfluous". However, at a later date during a project planning exercise they commented that they did not see the need to collect information at the beginning of the study, but they now saw it as valuable.

Whilst conducting a study such as this may appear a 'smart' way of using feedback from participants (at least I thought it was), ethical issues were significant, especially given my role in supporting the facilitation of FAD workshops. As noted in Chapter Three, this study required ethics committee approval, which in turn required the assurance of confidentiality to participants. My involvement in both the FAD facilitation group and in this study resulted in feelings of awkwardness. Two participants noted that they felt the formal consent process was "awkward and annoying". Four others explicitly checked on the assurance of confidentiality I had given them at the start of the conversation before giving information. Another commented that my delay in calling after the last workshop (until such time as I had contact details) resulted in them feeling unfairly pressured to provide useful material that they were less well able to remember. They also suggested that given that this was part of a paid job, they had expected it sooner. These comments suggest that even with repeat clarification that this study was a university research topic separate to FAD, it was not perceived as such.

I considered this research cycle valuable in that it provided access to feedback, some of which would clearly not have been obtained without assurances of confidentiality. However, it resulted in me feeling a sense of obligation to address the concerns that were raised. It also placed obligation on the facilitation team who had to respect my ability to manage any concerns raised, whilst realising that information collected was confidential. While a minimum of three participants (per project learning group) was used in an attempt to offer anonymity when summaries of reflections were passed back to the facilitation team, instances of more serious concern by individuals were managed by suggesting participants speak with others in the facilitation team. This process provided a way of managing facilitation team concerns. Others interested in conducting similar research may wish to seek an exemption from confidentiality to include the facilitation team, for ease of awkwardness (on the part of the interviewer) and potential for unease in the facilitation team.

This research cycle has built on previous understandings of the role of social learning in adaptive management in a number of ways. Firstly, it has extended current perspectives on the role of social learning discussed in Chapter Two. Secondly, it has demonstrated that in situations where there is integrity in the collaborative process (i.e., where there is

transparency, trust, involvement in decisions and where individuals can identify the incorporation of their ideas in the collaborative process), and where that process is responsive to the concerns of participants, individuals' comfort with the process increases, and scepticism about projects can decrease. Whilst there were identified benefits of these reflections in refining the design of the process used in FAD projects in a positive way, the research presented did not unveil any issues of major significance or discomfort that could lead to serious process problems, i.e., those where individuals experiences disrupt the group process in a way that leads to perverse learning (as described by Ascher 2001 in Chapter Two). In combination, lessons from research cycles four and five provided lessons on the value of reflection as outlined in the following section.

8.4 Lessons on establishing adaptive learning processes

These research cycles have led me to hypothesise that three tensions exist in micro-stages of adopting and establishing adaptive management. I refer to these tensions as consider, support and practice. Evidence for this hypothesis comes from consideration of my own experiences in establishing the research cases presented in sections 8.2 and 8.3, and from contextual information about projects revealed in this chapter. For ease of separation, these sources are referred to as 'my work with projects' and 'parent project'. Further, these tensions can be related to the constraints of adaptive management outlined in Fig. 2.4, Chapter Two, and thus may explain why particular models of adaptive management are more successful in some contexts than others.

8.4.1 Consider

In order for managers to consider the use of adaptive management, an initial tension must be overcome. This is represented by a trade-off between the shot-term outcome orientation of management and the costs of experimentation, which increase with more rigorous application of science principles (Walters 1997). The decision to adopt an adaptive style of management is therefore one that considers the risk of not learning under current management as too high.

In the case of the joint inquiry with RNRP (Chapter Eight), the strategic direction pursued was an attempt to build support for the argument that lessons from the Mainland Islands contribute to the capacity of DOC to manage biodiversity and therefore that their adaptive learning focus is justified. In one of the unsuccessful attempts at joint inquiry, a passive-adaptive learning response was considered a sufficient response to uncertainties associated

with the lack of knowledge about information transfer. Thus, the costs of not learning could be interpreted as being low. In FAD, this strategic direction can be interpreted as a response to changing levels of deer and thus changes in the potential affects on forests, i.e., an increasing number of deer with the removal of commercial hunting. The strategic alignment taken by this project is based on the need to know what deer control might achieve. An additional reason[30] for involving the public in doing so is that it may decrease scepticism in the research (both in terms of questions asked and results).

Reflections on the adaptive learning processes presented in this chapter suggest that a significant amount of reflection has already occurred when the choice to adopt an adaptive approach to management is made. In other words, the choice to adopt an adaptive approach depends on consideration of problem context from the outset. This may also explain why instances of the deepest levels of reflection were apparent in participant reflections from the outset. The role of reflection and instigators of adaptive management or adaptive learning projects at this stage to identify opportunities where management using an adaptive approach provides a useful means of managing uncertainty (i.e., either informational or socio-political). Resilience theory (see Chapter 2.2) suggests that potential opportunities for change are related to periods of reorganisation in the broader management context (Gunderson and Holling 2002). In FAD and RNRP, these opportunities to learn were taken. In others cases, for example projects where attempts at joint inquiry failed, managers continued to 'fight fires[31]' as a result.

8.4.2 Support

Managers who choose to use either adaptive management or adaptive learning processes must be convinced not only by the need to learn, but also that the risks to potential project support (i.e., the current management regime) and the institutional costs will be minimised. This second tension is evidenced as a trade-off between ongoing support for management (which is considered to be higher with trial and error approaches (Roe and van Eeten 2002)), and the institutional costs of learning such as financial and time commitments (which increase with more experimental forms of management). The establishment of more adaptive management

[30] Please note that the views represented here are my own and not those of the FAD project, nor do I mean to assert that they are endorsed by it. However, evidence to support this assertion can be found in the Policy Statement on Deer Control and documents detailing the process leading up to it that are detailed in Chapter 4.5. Within these documents, the role of future research, and the potential contributions of recreational hunters in achieving the proposed outcomes are detailed.

[31] In the case in point, the manager this comment refers to said that one reason they had not initiated data collection was that they were busy 'fighting fires'. One such fire was a call from more senior managers to demonstrate the value of their project or risk funding cuts.

practices is therefore dependent on commitment to learning by all involved, but particularly by management decision-makers.

In both of the case-studies presented in this chapter, institutional costs associated with my work were minimised by focussing on parts of projects, and therefore did not require substantial levels of institutional resources. At RNRP, the outcomes of the inquiry posed risks to project support that were potentially high given that results could have resulted in reconsideration of their adaptive-learning function. However, from the outset, staff stated that their project was somewhat resilient to changing strategic direction at a national level given the amount of local support for it. It appears that RNRP had created a coping strategy that enabled time to decide how and when to adapt and realign strategically. This alignment is somewhat similar (albeit on a much smaller scale) to the role of social networks in supporting more resilient management as described by Olsson *et al.* (2004). In the second unsuccessful case of joint inquiry, the costs of not learning obviously did not outweigh the costs of committing to it.

Within my work with the FAD project, information was fed directly into the parent project (on the request of a member of the facilitation team) in order to ensure that any stated concerns could be considered. While one of the team was interested in the detail provided, another was more concerned with any information that would suggest serious risk to the parent project success. Within the parent project itself, comments made by DOC staff demonstrate that building relations with communities is essential to ensuring support for projects thus reducing strategic costs of the project. In the case in point, the documentation and incorporation of local knowledge and the transparency of the project also affected the support afforded to the project by learning group members. Reflection on the tension between the need to learn but to minimise risks involved in doing so results in an emphasis on ways in which to minimise the potential opposition to adaptive management. Given that the socio-political costs of learning are borne at the local level (in the case of my work socio-political costs are borne by FAD and RNRP), involvement of those affected by potential changes in management is hence essential at this stage if support for adaptive management is to be sustained.

8.4.3 Practice

A third tension between the need for both local-level support and relevance to other interests exists when establishing adaptive management. This tension can hence be considered one that

relates to the effects of a project gaining prominence. The entire justification for the joint inquiry with RNRP can be considered a response to this. In effect, RNRP had become 'noticed' at a national level which led to criticism of the project purpose and resulted in the need for RNRP staff to strengthen their argument for their strategic direction.

In my work with FAD, the incorporation of individuals' perspectives in the design of subsequent group activities and the resultant changes made (e.g., changes made in the presentation of science knowledge, project purpose and role clarity, attention to concerns regarding the need to make underlying assumptions more explicit) can be viewed as a means of ensuring relevance to the parent project. In the parent project itself, the tension between ensuring support for adaptive management at the local level, and national level relevance was also evident. An example are the concerns identified by Affected Forest Users about the need to provide information about FAD to other interest groups in order that they were able to fulfil their asserted role of building project credibility and avoid socio-political tensions that could otherwise limit the utility of research. Differences in perspectives on the strategic alignment were evident among scientists involved in the project. One of four participants from this perspective group noted that they felt concern about the ability to need, and ability derive generalisable information from the projects (suggesting a need to ensure relevance to other interests), and another felt that there had not been enough attention to how managers would use the information (i.e., to ensure local relevance). Lastly, this trade off was expressed by two of three DOC staff who participated and raised concerns about the potential for micro-management by more senior levels of DOC that could impact negatively on relationships that had been formed at the local level. Commitment to the FAD parent project would not have been given without reference to the national level interests having been given from the outset.

These tensions were also evidenced in reflections on adaptive management presented in Chapter Seven. Consideration of the risks of not learning is evident in comments presented in Chapter 7.5.3 about the need for managers to be convinced of the significance of the uncertainties in management before considering an adaptive approach. The second tension was also evidenced in comments by one practitioner that their adaptive management project would not have been possible with the advent of media attention given to species recovery efforts. The third tension can be seen in light of practitioner concerns about the ability to iterate due to what they perceived as a reduction in the significance of uncertainties the project addressed.

The tension between ensuring both local relevance and national interest is, I believe, inappropriately managed by returning to a model of adaptive management whereby science dominates, public support wanes, and its application is resigned to cases where sufficient mandate exists to either over-ride local considerations in order to avoid the science-management tension, or to effectively manage the fallout from them. Instead, greater stability in direction is needed, in addition to accepting that at some stage, management may return to a model of passive adaptive learning focused purely on improving performance.

8.5 Chapter conclusions

The approaches have been demonstrated to make contributions to the ability to build reflection. The use of joint inquiry (research cycle four) provided an effective way of introducing adaptive learning to RNRP. The exercise was perceived as a novel way of working, suggesting that the staff had not been actively involved in this type of learning process before. The study of individuals' experiences of group process (research cycle five) also extended the list of factors contributing to and limiting social learning outlined in Chapter 2.5.2. Further, the information collected was useful in the design of subsequent activities within the parent project.

Three tensions were evident in the adoption and establishment of adaptive learning processes in these research cycles. Firstly, in considering adaptive management as a potential approach, a trade-off between the short-term outcome orientation of management and the potential for experimental rigour occurs. Secondly, a manager's support for adaptive management requires a trade-off to be made between the potential for ineffective management and the costs associated with learning that challenges underlying assumptions about the effectiveness of management. Thirdly, a tension between local-level support for adaptive management and a need to appeal to other interests may become more prominent.

These tensions have implications for the two emphases on adaptive management presented in Chapter 2.3.1: adaptive collaborative management and adaptive experimental management. If a more experimental form of adaptive management is pursued given higher levels of risk associated with not learning, then there is an increased role for reflection, both when initiating adaptive management and during its practice, in order that other trade-offs are managed in a way that enables support for adaptive management to be sustained. Therefore, there is a case for increased attention to collaborative processes rather than decreased attention. The limited recognition of this within the literature on adaptive management may be one reason that has

led to suggestions that more experimentally oriented approaches are limited to situations in which resources are managed by organisations with a commanding mandate, i.e., situations in which sufficient mandate exists in order to ignore local level interests that may otherwise affect project success. This chapter represents the last of four data chapters. The following chapter provides overall conclusions on the thesis, including a review of key findings, a discussion of these in relation to the aims of the project and suggestions for further research.

Chapter Nine: Conclusions

9.1 Introduction

The basis for this thesis, as outlined in Chapter One, lies in the notion that while adaptive management shows much promise from a theoretical position as an alternative approach to the management of large scale systems where uncertainties exist, it has proven to be less successful in practice. My assertion throughout has been that a new synthesis is required that can reconcile differences in emphases of the approach and support the realisation of that promise in practice. The relatively recent arrival of adaptive management within the Aotearoa-New Zealand context, particularly within the conservation management context, and its apparent experimentation emphasis suggests that practice-based concerns occurring in the international context may be at risk of being repeated here. However, I have also asserted that its relatively recent arrival provides opportunity to learn about practice in a way that addresses these concerns before discourses become ingrained and adaptive management proves little more than 'business as usual', as it has elsewhere (Duncan 2001). This research was guided by two questions:

Question 1: In what ways are current interpretations of adaptive management limiting its practice?

Question 2: What contributions can reflection-building approaches make in supporting the adoption and practice of adaptive management in the New Zealand terrestrial conservation management context?

The first of these questions provided the theoretical basis upon which I engaged in research. The second provided a means with which to develop substantive theory. As this thesis has developed, so too have my arguments about the practice of adaptive management. My initial position on the literature was that adaptive management was relatively under-theorised from a sociological perspective. Through critical analysis of the literature and the exploration of additional intersecting theoretical layers, this position has evolved to one that argues for the increased reflection on context in order to support practice. The use of action research, a grounded and responsive methodological approach that combines action and understanding of that action enabled insights to be gained about approaches that support the adoption and practice of adaptive management. The purpose of this closing chapter is thus to consider the implications of what has been learnt for the practice of adaptive management.

Through a review of key arguments presented in the chapters thus far, this chapter highlights the original contributions of this thesis to both its aims, i.e., to understanding limitations in current interpretations (Chapter 2), and to highlight the contribution of reflection building approaches to supporting practice in the Aotearoa-New Zealand context (Chapters Four to Eight). Individual chapter contributions provide a starting point from which to reflect, as a whole, on the practice of adaptive management with particular regard to the New Zealand context. In turn, limitations of this research are identified and recommendations for further research are made. The key argument developed about the practice of adaptive management is that its application as a specialist driven model of management and the subsequent expectation of a one-off problem 'fix' limits the ability to institutionalise it as an approach to continuous learning.

9.2 Chapter contributions

Chapters Two to Four of this thesis provide theoretical, methodological and context grounding for the thesis (respectively). As such, they are distinct from Chapters Five to Eight which provide iterative development of approaches to supporting the practice of adaptive management. Thus, the first three chapters provided a basis from which to engage in field-based research, and the last four provide understanding with which to revisit key assertions made. The material provided in these summaries highlights information critical to subsequent conclusions on the over-arching research questions.

9.2.1 Summary of theoretical grounding

Chapter Two provided the theoretical basis for this thesis. It began by providing a synthesis of current discourse, including the essence of adaptive management, a five-step learning orientated process. It then highlighted two divergent emphases: adaptive collaborative management and adaptive experimental management. The interpretation of various forms of adaptive management as approaches to learning positioned on a continuum from laboratory science to trial and error management enables the influence of context on practice to become more evident. Thus, rather than arguing for application of paradigmatic discourse, the argument for practice that is reflective of context can be made. The chapter concludes with a re-presentation of adaptive management as a learning schematic, and outlines potential approaches to support reflection on practice. These approaches include formative evaluation, for which a developing framework is outlined, joint inquiry and individual reflection on group process.

Chapter Three of this thesis outlined a methodological framework for the thesis. Action research was presented as a methodology that addresses the weaknesses of positivist approaches in understanding practice by providing an alternative methodology for both supporting practice and developing understanding from it. The synthesis of more specific forms of both action research and systems methodologies contributes to the argument for a generic approach to its application. Due to the dual emphases on both practice and research on practice, the application of action research involves iterative and inter-linked cycles of theoretical development and contextualised understanding. Finally, specific methods used to apply action research are detailed.

Given my argument about the significance of context to the practice of adaptive management, an outline of the conservation management context of New Zealand was considered necessary. This is provided in Chapter Four. The inception of the Department of Conservation (DOC) as part of the 1980s state sector reform brought together responsibilities for policy, advocacy and management of the conservation estate. However, DOC appears to have avoided the consequent splitting of organisational operations that occurred during these reforms. Instead, it has retained provision of policy, management and capacity development (i.e., science) functions. A capacity development function within the organisation was expected to support opportunities for adaptive management, given its inherent science linkages. However, a more recent review of DOC in 1996 increased line management accountability, and side-lined science support. This chapter then proceeded to provide an outline of adaptive management in the conservation sector, including more specific detail of the Mainland Islands and Adaptive Management to Restore Forests Affected by Deer (FAD) case studies. The practice of adaptive management was identified as being strongly experimental in focus.

9.2.2 Summary of engagement

Chapter Five presents the first of five research cycles. It was designed as a pilot study to determine if the bias towards experimental perspectives on adaptive management evident within case context literature was evident in practitioners' own perspectives on adaptive management. Whilst disparate perspectives were evident, adding impetus to the argument for formative evaluation, the significance of learning to the practice adaptive management had not gone amiss. Lastly, I realised that the structure of the formative evaluation framework developed in Chapter Two was itself based on different discourses on adaptive management

rather than integrating them, which led to a revision of the framework's structure. Further, this chapter highlighted the significance of Te Tiriti O Waitangi to the practice of adaptive management within the conservation management context of New Zealand, in particular, the significance of cultural redress and the implications of this for the participation of Māori in adaptive management.

Chapter Six had dual purposes: to reflect on the potential for adaptive management within the DOC ecosystem management focused Mainland Islands, and to determine the usefulness of the evaluation framework developed in Chapter Two and refined in Chapter Five. Key findings indicated that at best, given the lack of system models, Mainland Islands were implementing a passive-adaptive model of management. Further, participant reflections on adaptive management and its use in these projects highlighted two extant possibilities for further and more formal adoption: a 'research by management' approach, including a national-driven science emphasis, and a 'management by research' approach, enabling a focus on developing management capacity within constraints operating at a local scale. Reflections on the evaluation exercise resulted in redevelopment of the 82 evaluation criteria into 37 questions.

Chapter Seven tested the redeveloped evaluation framework with a group of practitioners from a range of projects explicitly identified as practicing adaptive management. Practitioners indicated value in the evaluation exercise, given that the framework enabled reflection on factors that were previously under-considered, and led (in some cases) to reconsideration of both project planning and reporting. Importantly, use of the framework with multiple case studies enabled issues for the practice of adaptive management within the New Zealand conservation management context to be elicited. Key issues identified included the commitment required to science, the lack of uptake of models, and problems with iteration after completion of the first cycle of learning. In combination, Chapters Five, Six and Seven represent an attempt to reflect on projects as a whole. However, my inability to work consistently within one project to develop and refine the evaluation framework and adaptive management practice at the whole project scale led me to explore alternative approaches for supporting reflection on adaptive management.

Chapter Eight details two research cycles where alternative approaches to reflection (i.e., joint inquiry and individual reflection on group process) were trialed. It is premised on the assertion that adaptive learning is central to the practice of adaptive management. The first of

these research cycles, conducted with specific Mainland Island groups, indicated that adaptive learning processes provide a new way of working. As a result of the inquiry itself, managers were able to develop arguments for changes to project planning that allocated time for information extension, an activity that was previously of under-estimated significance to the project by both managers themselves and more senior management. The second research cycle focussed on individuals' perspectives on group learning processes within the FAD project. Repeat interviews were also useful in demonstrating changes in perspectives over time and mitigation of individuals' concerns. When contrasted against literature on social learning in adaptive management introduced in Chapter Two, this research cycle extended previously identified factors that contribute to and limit social learning processes in adaptive management.

In combination, the two research cycles in Chapter Eight highlighted the significance of the micro stages of establishment of adaptive learning processes. Evidence was provided that showed projects progressed through a series of trade-offs associated with the constraints presented in Chapter Two, including trade-offs related to the costs of not learning, commitment to learning, and the effects of increasing prominence. My argument is thus that reflection on these trade-offs could make decisions that lead to particular forms of adaptive management, as they relate to a given context, more explicit.

Each of these cycles of research has implications for both the practice of adaptive management within the New Zealand context and for theory on adaptive management.

9.3 Reflections on conservation-based adaptive management in New Zealand

One of the key contributions of this thesis has been a novel analysis of the practice of adaptive management within the Aotearoa-New Zealand conservation context. The research has shown that the practice of adaptive management in New Zealand is typically specialist driven. Whilst adaptive management requires scientific expertise in order to construct system models and to ensure robustness in the application and analysis of management experiments, the scientific prerogative of emphasising external validity has implications for the institutionalisation of adaptive management.

Within the Mainland Islands cases, the emphasis on creating generalisible knowledge can be seen in the interpretation of adaptive management as an approach whereby management

actions contribute to a research agenda, i.e., the research by management perspective outlined in Chapter Six. As the prominence of these projects has grown, challenges to their strategic alignment have arisen. In order for these projects to contribute to answering science questions considered significant at the national level, a strategic research agenda first needs to be set, and appropriate science support provided. Within DOC, this provision of strategic agenda and specialist science support inherently occur outside of the line management structure. An example of this is the more technical review of Mainland Islands that initiated the development of such an agenda (e.g., Saunders 2000b). Since these reviews, a lack of strategic directive on the capacity development roles of the sites led projects to assess their purpose as sites for developing conservation management capacity and argue for appropriate resourcing to do so (Glaser 2004). The alignment of Mainland Island strategic direction alongside other intensively managed sites after the restructure of DOC science support in 2004/5 (See Ombler *et al.* 2004) provided security for this direction (Cumberpatch 2005). Identification of whether that learning ought to be focussed or have nation-wide 'appeal' does not however appear to have been clarified. Thus, in the appropriate emphasis for adaptive management, the required support for it and the implications of this for practice remain unclear.

Other cases of adaptive management in the conservation sector incorporate scientific expertise from outside of the organisation. As noted in participants' reflections presented in Chapter Seven, these projects have faced an inability to iterate. The desire to 'appeal' at a national level can also be seen as a response to ensuring continued project funding that is required due to the necessary science support.

When contrasted against background information on DOC provided in Chapter Four, the inability to institutionalise adaptive management as an operational approach can be viewed as a tension around the capture of adaptive management by scientists, and thus the expectation of adaptive management as a traditional model of science problem solving. The requirement of scientific expertise leads to projects that are essentially managed by 'scientists'. The investments made in such science lead to conditional funding associated with meeting nationally identified strategic needs or 'problems'. This increases the emphasis on creating more robust and generalisable knowledge. As a consequence of this science association and endeavour, the adaptive management approach is seen as a 'solution' to the management of uncertainties outlined as part of strategic problem definition, and thus the need to iterate and continue to develop understanding about complex systems is not realised or supported. A

paradox is therefore evident in recognising the need for robust knowledge, but accepting that the inherent purpose of management is to learn how to manage and address uncertainties affecting management at a given site. In the case of Mainland Islands the dual science directive and emphasis on line-management accountability has resulted in an inability to commit more fully to either form of adaptive management.

One way of addressing this paradox may be to throw money at the situation, i.e., more scientists and more project funding. However, this does not necessarily negate the desire for robust knowledge. The science prerogative for creating generalisable results remains. The resolution of concern about institutionalising adaptive management then becomes an issue associated with the alignment of that support. Although only one case example, a practitioner involved in this research presented in Chapter Seven was associated with a project including specifically attached science support, and did not indicate issues associated with the ability to iterate. This alignment of science support may offer an alternative to limited term adaptive management. However, issues remain given the line management focus on performance, synonymous with more limited forms of adaptive management (i.e., passive adaptive management). Thus, not only does adaptive management in the New Zealand conservation setting require consideration of how science support is to be provided, it also requires consideration of the alignment of adaptive management projects within the line management structure where projects compete for funding with other more outcome oriented projects.

Another concern regarding the practice of adaptive management within this context is the lack of integration of social perspectives on adaptive management. Whilst the significance of these is perhaps less within the conservation sector given the mandate of DOC, and a lack of contested values associated with the areas in which adaptive management is being applied, the argument for a more inclusive approach to management can be made for some of the cases explored in the thesis research. In Chapter Eight, consideration of the social context of management (including the participation of more junior levels of management and other affected stakeholders and the integration of their perspectives) was demonstrated to support the ability to work in a more adaptive way. The skills required to do so are also specialist in nature, and projects face the same fate as those requiring specialist 'science' support. The issue is potentially worse given the limited 'social science' support available within DOC (i.e., one scientist at the time of writing). The solution to this type of issue is likely to be in considering whether there are situations in which adaptive management can be turned on, and off, and then back on, and what the appropriate triggers might be for doing so.

9.3.1 Context limitations and recommendations

A number of factors were identified as contributing to the relative success of adaptive management in Chapter Seven. Whilst I have focussed on the role of science across each of the steps involved in the adaptive management process, a further avenue for analysis could have been to rank the relative importance of each of these factors, and therefore provide an example of the most crucial steps in the process. This analysis could provide an additional useful avenue for research.

It is with great regret that I have been unable to follow up on the noted potential significance of Te Tiriti O Waitangi to the practice of adaptive management, as outlined in Chapter Five. Te Tiriti O Waitangi places special significance on the role of Iwi as partners in the management of the landscapes of Aotearoa-New Zealand, including the management of conservation areas. My attempts to involve such a group in this thesis proved unsuccessful given tensions between DOC and a local runaka at the time at which redress claims were occurring. Internationally, the learning process inherent in adaptive management has been argued as akin to the processes involved in the development and application of traditional ecological knowledge (Berkes *et al.* 2000). Adaptive management therefore has the potential to provide a process less foreign and more akin to tikanga Māori than is afforded by rational planning models common in environmental management. To this end, the ways in which adaptive management processes and tikanga Māori can complement one another is also a deserving avenue for further attention in research. A comparative investigation of New Zealand and other countries may serve to identify whether the significance of Te Tiriti O Waitangi is different to governance relationships between indigenous people and colonising governments elsewhere.

The reflections of participants involved in FAD on the value of local knowledge, and my observations of local knowledge of Mainland Island staff during field visits suggest that the acknowledgement and inclusion of this form of understanding may also be important to ensuring support for adaptive management at the local level. Thus, the potential for adaptive management to act as a way that supports ongoing learning through the inclusion of forms of local knowledge deserves further attention. Research by the likes of Olsson *et al.* (2004) suggest that it is significant in creating social networks that can act to support capacity for adaptive learning, albeit in a less formalised way. What may be significant within the New Zealand conservation management context is the way that local knowledge from within and

outside of organisations, in addition to tikanga and matauranga Māori, combine. The interaction of different knowledge cultures within management partnerships and the implications of this therefore provides another avenue for further research.

Within a broader New Zealand context, the arguments about the role of 'experts' in adaptive management and the identified limitations of this for institutionalising adaptive management in the conservation sector may be more or less apparent. For example, the context of the agriculture sector differs in that a public mandate such as the preservationist mandate of DOC does not exist. Thus, choices to learn may be more issue driven, and effects of project prominence may be less pronounced. In the regulatory sector, for example the management of common-pool resources (e.g., water), the costs of not learning can be expected to be equally or more pronounced, but the costs of committing to learning may mean even greater problems given the diversity of stakeholders and the expense of litigation. The fisheries sector in Aotearoa-New Zealand was another area where experience with adaptive management has been identified as occurring as a once-off process, and where collaborative processes are identified with separately from adaptive management (see Chapter 1.2.2). A comparative study of the conservation and fisheries sectors is therefore suggested. The summary table of factors identified as contributing to promoting and limiting success of adaptive management (Chapter Seven) could provide a useful starting point for such a comparison. Similarly, a comparison of the practice of adaptive management in other countries may serve to highlight the uniqueness of these issues to the New Zealand context.

In discussing the limitations of institutional structures that influence the practice of adaptive management in DOC, I have highlighted that there may be cases where adaptive management can be turned on, and off, and on again. This is also likely to be of relevance to other countries where adaptive management is being practiced, and the indicators for doing so deserve further research. Similarly, other conclusions are likely to be relevant to other organisations and countries depending on the similarity of the institutional structure, mandate and culture evident in the cases involved in this research.

My recommendations for the practice of adaptive management in the New Zealand context are almost inextricably intertwined with what I see as a significant contribution to more general reflections on adaptive management.

9.4 Reflections on adaptive management

As the research presented progressed, the need for additional theoretical layers became apparent. A second key area of original contribution in this thesis research is, therefore, through its novel synthesis of the current literature and its intersection with theories about learning and more specifically, the role of reflection in learning. Rather than emphasise the differences between variant forms of adaptive management and argue for a particular form as has been done elsewhere (e.g., Hunter *et al.* 2003), I have argued for reflection on practice context, through consideration of a series of management tensions (Chapter Eight). The requirement for this is that adaptive management is accepted as an approach to learning where complexity, uncertainty and change are significant factors that affect the outcomes of management.

This thesis has highlighted that the practice of adaptive management that integrates social and ecological perspectives requires a focus on local level relevance. Unlike ecological science, a sociological contribution need not have the same desires of generalisability, given that different epistemologies are employed. Thus, the role of ecology in adaptive management can be challenged on the basis of a desire to appeal to some meta-framework beyond that of the purpose of adaptive management itself, i.e., improve the ability to respond to change at a more localised level. When adaptive management is science or specialist drive, concern for other interests (i.e., generalisability) result in science operating outside of its operational context.

Explicit reflection on practice-based situations presented in this thesis has been useful in developing approaches that build reflection on context. This has been enabled through the use of action research methodology, which has proven useful in reconsidering assumptions about the practice of adaptive management in the cases involved. The reflection building approaches used in this thesis included formative evaluation for reflecting on the whole of management. This framework developed was demonstrated to be useful in eliciting consideration of both experimental and collaborative emphases of adaptive management.

The use of alternative approaches to reflection on the whole of management was prompted by my lack of access to such cases. These cases indicated a role for reflection in supporting individuals and groups as they themselves learn to learn in an adaptive way. A number of tensions were highlighted that make explicit the links between contextual challenges and the micro-stages of adoption and practice of adaptive management. The argument here is that the

conscious and deliberate practice of adaptive management ought to consider, in an explicit way, the trade-offs that occur when adopting and practicing adaptive management.

While this research was developed in the Aotearoa-New Zealand context, recent publications by other academics serve to highlight that the issues raised are not limited to this context. Catherine Allan's PhD research in Australia (Allan 2004) also argues for increased understanding of social learning processes within adaptive management and for the use of evaluation to improve the practice of adaptive management. Further, Keen and Mahanty (2006) have made explicit the links between adaptive management and learning theories. This work uses case studies from the Pacific region.

9.4.1 Theory limitations and recommendations

The framework developed (see Fig. 7.2, page 136 or Appendix Three) provides a starting point at which to structure debate on adaptive management and to compare practice both within New Zealand and internationally. In its current form, it provides a starting point for structuring debate about the approach in a range of other contexts and situations where criteria may be added or adjusted dependent on such reflection. Further refinement and testing of the framework in other situations is expected to provide a useful means of eliciting and extending current understanding of the way in which adaptive management is practiced. Further, the one-off use of the evaluation framework does not indicate the ability of such a process to make real changes to the practice of adaptive management, although it can arguably be expected given that other instances of participatory evaluation do (Gujit 1999).

While the development of an adaptive-learning model is signified in Chapter Eight as a means of progressing reflection on learning within existing management structures, a limitation of this thesis is that it has not identified the extent to which adaptive learning processes developed in project parts are transferable to other parts or the whole management processes. An attempt to do so would require access to cases from initiation to completion and beyond. Longitudinal studies on the impact of adaptive learning processes may provide a means for future research to establish this. Further, exploratory research on the benefit of specific reflection on the trade-offs identified is suggested.

The adaptive-learning process inherent in adaptive management is asserted as being the central component in its practice. Given that debate currently exists between the discourses on adaptive management and that questions have been raised about the effects of specialist

oriented perspectives on the ability to institutionalise adaptive management, I suggest that the retro-fitting of adaptive management to pre-existing management ought to focus on the ability to gain buy-in to adaptive learning rather than adaptive management per se. Awareness of the potential problems that may arise with specialist driven adaptive management is needed in other cases. As has been highlighted in Chapter Seven, there may be a case for 'turning on' and 'turning off' adaptive management. If adaptive management is to be used in this way, and management is to avoid the command-control pathology outlined in Chapter One, then signals for doing so need to be based on ecological and social indicators of uncertainty rather than the institutional costs associated with learning.

My own learning process has evolved significantly over the course of this thesis. While more specific reflections are included in Chapter Three, I truly believe that action research remains an art form that must be learnt by experience as must any other research methodology. Over the course of this thesis, my means of initiating dialogue with case studies evolved from approaching senior level DOC staff, to approaching lower level DOC staff, whilst remaining close to key critics whose opinions I also respected. One might also add that I have been fortuitous in case-study involvement. These reflections highlight some key limitations of the research methodology and the way I applied it.

Firstly, my approach to initiating dialogue seems to have avoided the middle level management staff involved in projects. Whilst they were approached and included in the research presented in Chapters Six and Eight, a lack of time and their apparent insistence that they had little to contribute has limited the strength of their voice in my research. And it is now that I realise they perhaps hold the key in institutionalising adaptive management given that can provide the slack needed to marry performance orientated management, and learning orientated science. Secondly, I like to think that I have myself created research opportunities with the cases involved in the thesis. However, as noted in Chapter Three, action research remains limited in utility to those cases where access is permitted. This limitation is explained nicely by revisiting the insights on the learning process provided by Schon (1987) in Chapter Three: that learners, when confronted with challenges to their current understanding either reject the challenges, or own the outcomes. However, the crucial challenge remains: the need to first convince managers that the costs of not learning are too great to ignore.

9.5 Last words

The field of adaptive management has evolved considerably since the initiation of this thesis. In January 2003, I developed a website of links to resources on the topic. While internet data remains at best anecdotal due to issues associated with search engine prominence, a 390% increase in unique visitors occurred between the first and last 12 months of operation (up to a total of over 200 visitors per week), demonstrating the amount of interest in this field. Almost as if to avoid confusion and (mis)practice, or perhaps reticent of a growing body of shared experiences in implementing the approach, Hollings' original notion of resilience (Holling 1973) appears to have been revisited and has itself developed into a body of theory on management that has 'exploded' in girth and depth over the past five years (for example, Carpenter (2001), Folke *et al.* (2002), Gunderson and Holling (2002), Berkes *et al.* (2003), Redman and Kinzing, (2003), Olsson, (2003) and Walker *et al.*(2002)). Whilst I believe that this has served to re-emphasise the importance of learning that underlies adaptive management, the sceptic in me remains concerned that it serves to avoid an apparent feeling of 'colonisation' by 'social scientists' of what was essentially an approach that developed from the intersection of ecology and environmental management. My concern here is not about the value of theoretical development, but that the practice of 'resilience management' (Walker 2002) may face the same criticisms that adaptive management did in the 1980s and 1990s.

This thesis has contributed to the continued development of adaptive management in multiple ways. Firstly, it has provided a novel theoretical synthesis that links adaptive management, learning and reflection to highlight the significance of practice context. Secondly, the development of a formative and participatory evaluation framework is, to my knowledge, the first attempt at whole project reflection. Especially significant is the emphasis on both experimental and collaborative emphases at each management step. In detailing the refinement of the framework over successive research cycles, I have provided detailed examples of the implications of different interpretations of adaptive management, and provided the first multi-case analysis of adaptive management in the New Zealand conservation management context. This is especially relevant in that it makes novel contributions to understanding the implications of institutional context on the practice of adaptive management, drawing attention to practice issues of retro-fitting adaptive management, and for the potential need to move between different operational modes in practice. The research has also extended factors identified in the international literature that contribute to and limit the practice of social learning as part of adaptive management. Lastly,

this research has identified a series of context specific limitations that will affect the operational approach and emphasis of adaptive management, thus offering a starting point for linking management context and the current emphases in adaptive management.

At this point, I return to the cartoon of Calvin and Hobbes presented in the introduction of this thesis. 'Real world' complexities remain the source of a paralyzing decision: to manage associated risks by attempting to learn while we manage, or to ignore the need to learn and act anyway. To these ends, my own interests remain relatively simple: irrespective of academic debates on the discourse of adaptive management, the everyday manager is still faced with the challenge of complexity; supporting him or her in making explicit the underlying reasoning for decisions about how to confront complexity can only serve to improve the likelihood of learning from those decisions.

The last words of this thesis deservedly go to those who have attempted to practice management in an adaptive way. Whilst the practice of adaptive management is not without problem, and the organisations that support it create further tensions for practice, the challenge of uncertainty and the need to learn about more effective ways of managing it has not gone amiss. I believe that this remains first and foremost the essential ingredient in building the capacity of the human race to be sustainable. Being able to work with the people who contributed to the 'data' chapters of this thesis and the opportunities they created that formed the basis of lessons within this thesis was an honour and a privilege. My hope is that I have contributed analysis and reflection that make those lessons accessible to others.

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Appendix One: CD-ROM of Am-Links website

This site was hosted on Http://student.lincoln.ac.nz/am-links from January 2002 – June 2006. To access the website open the file "am-links.html".

Appendix Two: Information forms

Research cycle two

Consent form for participation in interviews

Interviewer:
Chris Jacobson
Environmental Management Group
Lincoln University
P.O. Box 84
Canterbury
Ph 021 1772566

Interviewee:
Name:
Position title:
Office:

Details:
You have been invited to participate as a subject in a project exploring the perceptions and understandings of the concept of Adaptive Management. I'm interested in gaining an understanding of the various perceptions that exist about the concept, how adaptively the Department of Conservation might be managing its Mainland Islands, and how this might be improved.

Your participation in this project will involve an interview of approximately one hour in duration, either by telephone or in person. During this interview notes will be made in relation to your comments regarding this subject. The results of this work will be collated in the thesis and may be published. All comments made will remain confidential between myself (the interviewer), your self (interviewee) and my supervisor, Dr. Stefanie Rixecker who will hold copies of these notes – your name will not appear in any documents. However, due to the relatively small group of stakeholders I cannot in all cases guarantee anonymity.

Please contact myself, or my supervisor (Dr. Rixecker, available on 03 325 2811 extn. 8377) if you have any concerns regarding your participation.

Consent:
I agree to the stated interview given the description presented above.

Signed: Date:

Research cycle five

Lincoln University
Environmental Management Group
Environment, Society and Design Division

INFORMATION

You are invited to participate as a subject in a project entitled Understanding Social Learning to Support Adaptive Management, which forms part of a larger PhD study exploring the capacity to move adaptive management from theory to practice.

The aim of this project is to develop an understanding of individuals' experiences of adaptive management. This project sits alongside the DOC 3673 "adaptive management of forests affected by deer" that you are involved in. Adaptive management, as you should be aware, involves a collaborative effort to explore our understanding of a system, so we can make some predictions about an uncertain situation.

Your participation in this project will involve interviews following DOC 3673 research group activities up until the commencement of deer culling at the associated study site/sites. A standard series of questions will be asked for each interview occurring after each activity. Interviews will take between 15 and 20 minutes, and will be conducted either by telephone or in person. The questions ask you to reflect on your experiences of each DOC 3673 activity, and of your perspective of the project overall. It is noted that reflecting on your experiences within DOC 3673 may be challenging to you personally. Your participation will not influence the success or longevity of DOC 3673.

Notes will be taken in interviews. Key themes from these interviews for the research group will be collated and made available to the project leader and learning group facilitator. The information is intended to be incorporated into the design of subsequent research group activities within DOC 3673. However, as this is an additional study to DOC 3673, and not an integral part of it, there is no guarantee that changes will be made that will satisfy your concerns – the extent of their incorporation is up to (a) the DOC 3673 project leader (Dr Clare Veltman), and (b) the learning group facilitator (Dr Will Allen). To ensure confidentiality in presenting key themes from interviews to Clare and Will, a minimum of 3 participants from the research group is required. Additionally, results from multiple learning groups and the research group will be collated and may be published. Explicit links between key themes and the specific learning groups from which they arose will be not be made.

Under no circumstances will the identity of participating individuals be made available without an individual's consent, other than to myself, my supervisor (Dr Stefanie Rixecker) and the Divisional Secretary (Jane Swift) who will store the data. Participants may withdraw from the research (including any data they have provided) without question of reasoning. Again, such withdrawal will not influence the success or longevity of DOC 3673.

The project is being carried out by Chris Jacobson, a PhD student, who can be contacted at (03) 325 3838 extn. 8758, or Jacobsc1@lincoln.ac.nz She will be happy to discuss any concerns you have about participation in the project. Additionally, Chris's supervisor Dr Stefanie Rixecker can be contacted on (03) 325 3838 extn. 8643 or rixeckes@lincoln.ac.nz for additional inquiries.

This project has been reviewed and approved by the Lincoln University Human Ethics Committee.

Appendix Three: Framework for reflecting on the practice of adaptive management

Framework for reflecting on more adaptive management

Key:
- G This aspect is done well
- Y This aspect is not done as well as it could be, it might limit management performance
- R This aspect needs to be addressed as it is limiting the way we manage
- B This aspect is not relevant or important to us

Step 1: Problem scoping	Rate
1.1: Goals	
a Do you have a shared vision for your project and a set of goals to match?	
b Are the ecological boundaries of management clearly defined? (temporally/spatially)	
c Do goals consider ecological and social aspects of the management context?	
d Are goals aimed at managing uncertainty?	
e Have both social and ecological benchmarks for success been created?	
1.2: Collaboration	
a Have relevant stakeholders been identified and provision made to involve them?	
b Have communication networks been identified and a process for ongoing communication been established?	
c Do you have adequate capacity for your project? People? Skills? Resources? Institutional support?	

Step 2: Model building	Rate
a Has a model of the system being managed been developed?	
b Have relevant sources of knowledge been identified and drawn together to use in the model?	
c Have uncertainties in knowledge and assumptions in the model been acknowledged?	
d Have issues associated with both temporal and spatial scales been considered (e.g., lag effects or invasion risk)?	
e Is the model translatable for stakeholders and policy makers?	

Step 3: Action	Rate
3.1: Planning	
a Have management options been identified that meet goals and are they stated as hypotheses?	
b Have predictions been developed for each option?	
c Have stakeholders been included in decision-making?	
d Have the risks and trade-offs between different management options been made	
e considered?	
Have ecological imperatives been considered equally with economic and social imperatives?	
3.2: Science considerations	
a Have management actions been designed as experiments and are they recognised as such?	
b Have the limitations of methods been recognised?	
c Has focus been given to the biological significance?	
d Have compromise and constraint been accepted?	
e Has an appropriate running time been considered for experiments?	

Step 4: Monitoring	Rate
a Is monitoring conducted systematically and in relation to hypotheses?	
b Are short and long-term responses monitored?	
c Are appropriate criteria used in indicator selection?	
d Have stakeholders been given an opportunity to be involved?	
e Has data been collected so that management processes can be evaluated?	

5: Evaluation	Rate
a Is evaluation conducted systematically and in relation to goals?	
b Are both process and experimental lessons documented?	
c Is the management process transparent?	
d Is the process iterative?	
e Is evaluation completed in relation to the timing of ecological processes?	
f Are failures and unexpected results treated as learning exercises?	
g Are both social and ecological uncertainties evaluated?	
h Has the appropriateness of goals evaluated?	
i Are management and learning processes evaluated?	
j Are practitioners and organisations self-critical?	

Appendix Four: Reflection exercise

My goals for the session:

Re-cap purpose:

- To demonstrate MIs add value to DoC through the learning done there
    1. Can information transfer be measured?
    2. Who receives what information?
    3. Is RNRP given credit for it?

1. Too much general information, so focus on technical and get a summary of general from front desk and report.

Reflection:

- What worked well?
- What worked less well?
- What would you do differently?

2. Who receives information?

Reflection:

- Was the data what you expected? Why/why not?
- What was most surprising?
- What dies this mean for the way you provide information? Would you change it? Why / why not?

3. What is RNRP given credit for?

Reflections:

- Was it what you expected? Why / why not?
- What was most surprising?

4. Overall reflections:

- What was most useful about the study?
- What was least useful?
- What surprised you most?
- What does it mean for RNRP? DoC?
- What CJ got out of it

Appendix Five: Mainland Island information transfer presentation

Information Transfer: Yes – it really does happen!

Matt Maitland
(Rotoiti Nature Recovery Project)
Chris Jacobson
(Lincoln University)

Information Transfer

- The *potential* for Mainland Islands to contribute to capacity development for biodiversity conservation has been *recognised* and *endorsed*.
- MI's have been challenged in the past about *demonstrating* information transfer.
- There has been debate regarding whose role it is to *disseminate* information.
- MI's have *asserted* that they have always played a significant role in info transfer.

RNRP – a case study

- Record and measure information transfer by:
  - Origin of request
  - Type of request
  - Medium of transfer
  - Attempt to quantify effort required
- Participants:
  - St Arnaud Area Visitor Centre staff
  - Rotoiti Nature Recovery Project A2 ranger staff
- Direct transfer: interpersonal exchange
- Indirect transfer: web, reports, newsletters, media, Chinese whispers.
- Search for evidence of RNRP learnings transferred.

Fig 1: Model of information flows from RNRP. Data was collected from repositories marked red, providing information about connections marked green. Connections marked red are already reported on.

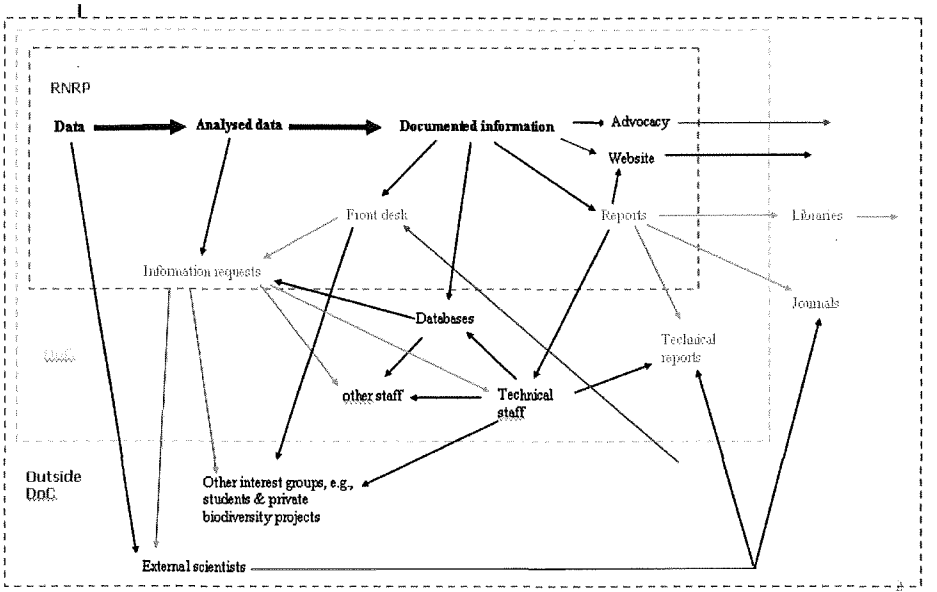
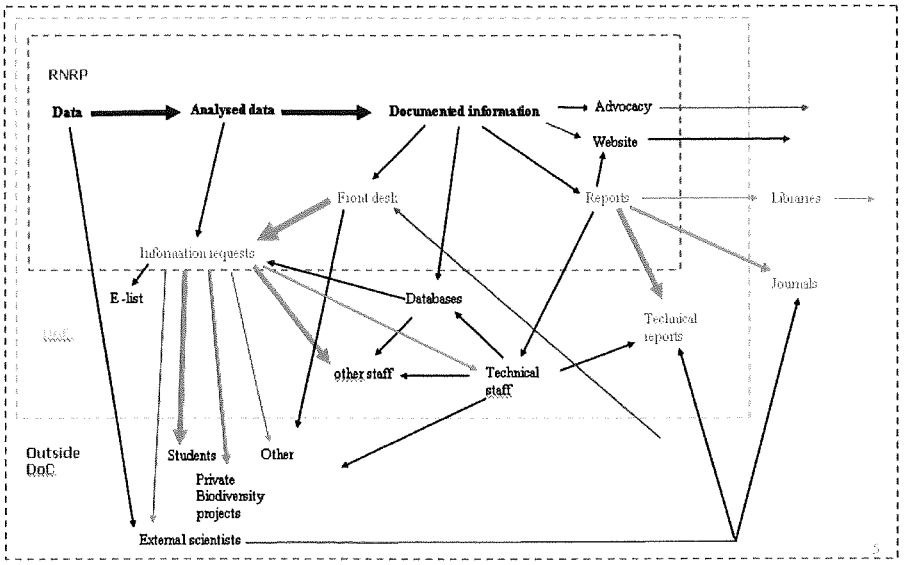


Fig 3: Model of information flows from RNRP with relative amounts of information transfer from each measured source.



Mechanics

- How?
  - Email (78% (internal =90%)), phone (13%), person to person (9%)
- Who?
  - Internal 45%
  - External 55%
- Test against the 'model' (Wright *et al.* 2003)
  - Confirms preference for informal
  - Higher incidence of email

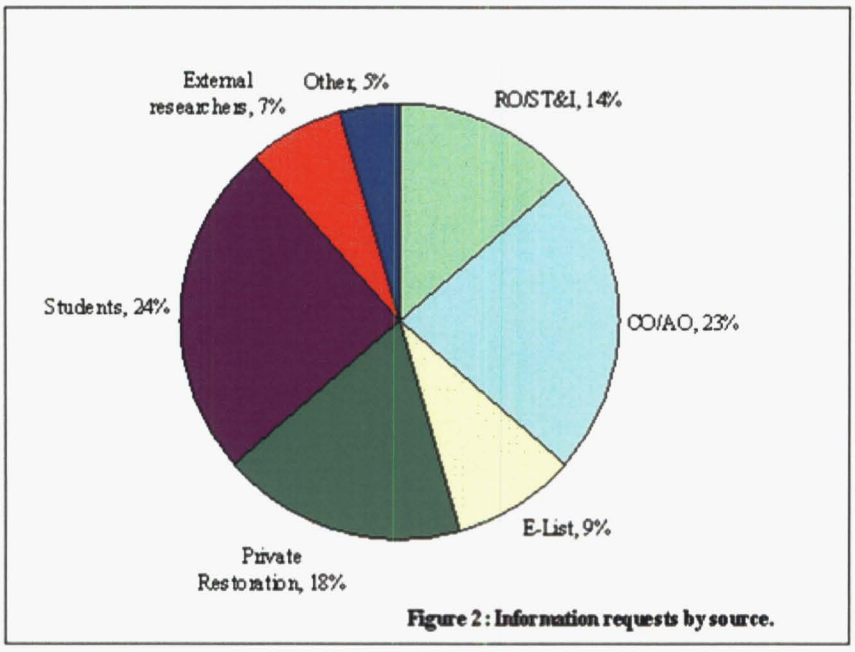


Figure 2: Information requests by source.

Table 2: Summary of request sources in relation to information type by percentage of total requests (N=49, 1dp)

	Wasp	Bird	Rodent	Stoat	Other pest	Vegetation	Costs	Other	TOTAL
RO/ST&I	2.0		2.0		6.1		2.0		12.2
AO/CO	6.1	2.0	8.2	2.0	2.0				20.4
E-List	2.0		2.0	2.0	2.0				8.2
Private Project	2.0	2.0	20	2.0	4.1			2.0	14.3
Students	8.2	4.1						10.2	22.4
Research Organisations	4.1					2.0			6.1
Other		2.0						4.1	6.1
Not recorded	4.1	2.0	2.0				2.0		10.2
TOTAL	28.6	12.2	16.3	6.1	14.3	2.0	4.1	16.3	**100.0%**

information on pests was most often sought (65.4%) compared with other information (34.6%)

Requests identified as internally sourced were almost completely pest focused (95%)

Records identified as externally sourced emphasised other information, including edge effects, project size, other monitoring data, restoration planning, and maps (33.3%), and wasps (20.8%).

Effort

- Estimated recording rate of 80-90%
- Biased toward external requests, and quieter times.
- 40-80 hrs p.a. per staff
- c. 5% total time
- Comparable to Conservancy office staff and departmental Scientists.
- Effort has been contained by production of resources to aid dissemination
- Volume vs type. Not all requests are equally demanding of time.

Secondary transfer method

- Identify key lessons from RNRP
- Search for evidence of above in published reports and journal articles.
- Note level of acknowledgement.

Secondary transfer results

- 48% no acknowledgement
- 39% some acknowledgement
- 13% co-authorship

Conclusions

- Evidence of transfer from RNRP to DOC and beyond exists.
- Preference for 'informal' mechanisms, which does not mean lacking robustness as info filtered via analysis/reporting.
- RNRP 'strengths' are targeted.
- RNRP staff spend similar time responding to information requests as departmental scientists.
- Secondary transfer difficult to measure.
- Uptake and application of information transferred even harder to measure.